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PRESENT STATUS OF INVESTIGATIONS CONCERNING ANTIQUITY OF MAN IN CALIFORNIA[1]

THE fact that archeologists and historians have been interested in the problem of the antiquity of man in California for the past 60 years is due in a considerable measure to the peculiarity of the problem in that region. The California area offers exceptional opportunity for a great variety of studies in archeology and anthropology, and especially for those dependent upon our knowledge of geological processes of the present and of the period immediately preceding. The fact that the coast region of California seems to have been in almost continuous movement throughout the later geological periods means that there has been continuous erosion accompanied by continuous deposition, giving us at the same time a record of the processes of erosion and deposition and of the life of the region in this period.

It has been realized from the beginning of our studies on the Pacific coast that satisfactory conclusions regarding the antiquity of man in California can not be reached within any narrow time limits, and that no single mode of attack may be considered sufficient in itself. At the initiation of the studies conducted at the University of California four lines of investigation were laid down: (1) Tracing man back in time through an examination of the great shell mounds of the coast region, the most critical study being given to the lowest or earliest deposits. In this work opportunity was offered for going from the known culture of the uppermost layers of the mounds back to a period in which conditions may have been quite different from those governing the life of the Indians of the last centuries. (2) The thorough investigation of all available cave deposits, whether Recent or Pleistocene, with particular reference to possible human occupation. (3) A careful study of those Pleistocene and Recent land, stream, lake and marine formations in which the occurrence of human remains or relics appears possible. This comprised a study of many Pleistocene formations and the collection in them of all obtainable fossil remains. (4) A careful review of all evidence relating to the reputed occurrence of implements or human remains in the older gold-bearing gravels or other ancient deposits of a similar nature in California.

[1] Read before the National Academy of Sciences, Washington, D. C., April 29, 1924.

After practically 25 years' research on the antiquity of man in California from the point of view of the archeologist, anthropologist, paleontologist and geologist, it is clear that the problem is not only extraordinarily interesting but is exceedingly complicated. There are many evidences in caves, in alluvial and stream deposits, in the shell mounds and in asphalt deposits, indicating the occurrence of man on the Pacific Coast for a period which must in all probability be measured in terms of many thousands of years. Up to the present time all the human remains discovered are of what have been recognized as modern types. So far as has been determined they do not differ materially in their characteristics from the various races included within the group of the American Indians of to-day. The implements and other evidences of man's handiwork are also in general of modern appearance and different from the ancient types known from the Pleistocene deposits of Europe.

Up to the present time no definite evidence has been secured in California of the occurrence of human remains in a geological formation older than the present or Recent period. Although there are occurrences which have suggested the possibility of man's existence in the Pleistocene or the period immediately preceding the present, most careful investigation has not up to the present time given us definite evidence indicating that either human remains or implements produced through the work of man have been recovered from deposits antedating the present geological period.

Though the geological evidence before us does not give for the Pacific Coast of America any clear proof of man's presence in the Pleistocene, during which he is known to have been distributed widely over the Old World, this must not be interpreted to mean that the human race has not been present in that region for many thousands of years. A time measured in thousands or perhaps tens of thousands of years would naturally be required for the development of such divergence as we know among the physical types of America, and would also seem to be required for origin of the differences in culture and in language so abundantly represented among the aboriginal peoples of the western hemisphere. The geological evidences of occurrence of man in California permit our considering the possibility of his presence there for at least as long a time as seems required by the evidence of his physical and cultural differentiation on this continent.

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A RECENT DISCOVERY OF ANCIENT HUMAN REMAINS IN LOS ANGELES, CALIFORNIA[1]

Introduction

In March, 1924, the Thomas Haverty Company, in cutting a trench preparatory to laying Section 11 of the north outfall sewer for the city of Los Angeles, encountered human remains at a depth of approximately 19 feet. Through the interest of Mr. George Hess, vice-president of the Haverty Company, the human remains were submitted to Dr. William Alanson Bryan, director of the Los Angeles Museum of History, Science and Art. The museum has appreciated greatly the courteous service rendered by the officials of the Haverty Company in the excavation of the locality where the human bones were found. Under the supervision of Dr. Bryan, and with an appropriation by the Board of Supervisors of Los Angeles County, the investigations are being continued in the vicinity of the original locality.

Location and General Features of the Region of the Discovery

The locality is situated approximately one third of a mile west of the Angeles Mesa Drive and 300 yards south of the tracks of the Pacific Electric Air Line, on the Spanish land grant called Paso de la Tijera (Santa Monica Quadrangle, U. S. G. S.), between Los Angeles and Culver City. The Pleistocene asphalt deposits of Rancho La Brea lie three miles to the north and slightly to the west of this locality.

The region in which the human remains were found is a relatively flat or slightly undulating country bordered on the southwest side by the Baldwin Hills. These hills rise rather abruptly along their northeast front to a height of over 500 feet. The Baldwin Hills are presumably traversed by a fault (Inglewood Fault) extending in a north-west-southeast direction and emerging from the hills near their western border. The valley or plain area along the northeast front of the Baldwin Hills and in the immediate vicinity of the locality where the human remains were found has an elevation of 100 to 125 feet above sea level, and is drained by Ballona Creek. This stream does not possess much of a gradient and within very recent times (topographic survey 1893) marsh lands and ponds featured its course in the northern portion of the land grant Paso de la Tijera and in the southern portion of the land grant Las Cienegas. To the north of this marsh area the land surface becomes gradually higher toward the base of the Santa Monica Mountains.

[1] Read at the meeting of the National Academy of Sciences, Washington, D. C., April 29, 1924.

NATURE AND OCCURRENCE OF HUMAN REMAINS AT THE TYPE LOCALITY

At least six human individuals were found between the levels of 19 and 23 feet below the surface and within an area of not more than 12 square feet. Five individuals represented in this group were adults. A sixth individual, somewhat younger, may be a female. The structural characters of the skulls, so far as comparisons have been made, are those of modern types. The skulls do not exhibit the primitive features seen in the Neandertal man of the European Pleistocene. The remains resemble closely those of American Indians but have not been definitely determined as belonging to racial types represented by the Channel Island Indians of Southern California. There is undoubtedly resemblance between the two forms, but further comparison should be made, particularly with a larger series of modern types than that which has been available to the writer.

The osseous material was not scattered and the skeletal elements for some of the individuals at least were observed to be in normal position. Some of the human remains show considerable replacement of the bone material by mineral matter. In other specimens this replacement does not seem to be so great. A chemical analysis of the specimens has not yet been made. The occurrence of the material at a depth ranging from 19 to 23 feet and the lack of evidence of disturbance of the overlying deposits preclude the possibility of burial. The osseous material was not washed in, and its occurrence suggests rather a miring under bog or marsh conditions, presumably prior to the accumulation of the greater portion of the deposits that now overlie the human remains. A quartzite boulder, regarded as an implement by Dr. Edgar L. Hewett, and a small awl-like object were found in the sedimentary materials removed from the pit at the human locality. Data regarding their position in the section are not available. No remains of Pleistocene or of recent mammals were secured from the deposits in which the human material occurred.

The section at the type locality (Locality 1) presents a conformable sequence of deposits, consisting largely of drab- or olive-colored, unconsolidated, micaceous sands and sandy clays. A light-colored sand, eight inches thick, occurs four feet below the surface. In the entire exposure horizontal bedding is suggested only by the light-colored sand at the four foot level and by dark carbonaceous bands occurring at three lower levels. The upper and middle dark bands, at depths of 10 and 14 feet, respectively, are sharply set off in color from the materials immediately above, but grade downward in each case into drab-colored sand or sandy clay. The upper and middle carbonaceous bands are rather persistent and have been observed for nearly a mile along the line of the Haverty ditch on Section 11. Small nodules of gypsum appear below the upper margin of the second dark band. The deposits above this horizon appear to be quite gypsiferous. Numerous fresh-water molluscs were found above the second or middle dark band and scattered remains occurred below the upper margin of this horizon. Dr. A. J. Tieje, of the Los Angeles Museum, has determined the following forms:

Helisoma (Planorbella) trivolvis Say
Helisoma ammon Gould
Lymnaea solida cubensis Pfeiffer
Lymnaea (Galba) truncatula Müller
Physa cf. hypnrorum Linne
Physa sp.
Pisidium sp.

A small crustacean, referred tentatively to the genus *Porcellio*, was also found. The molluscs represent types living to-day and are regarded by Dr. Tieje as indicative of quiet waters and of swamp or marsh conditions.

The third or lowest zone of dark, carbonaceous sand occurs at a depth of approximately 18 feet and is narrower and not so well defined as the middle and upper bands. A few inches above this horizon is a thin (1 inch thick) concretionary layer, distinctly more consolidated than the surrounding sands. The bed in which the human remains were found lies below the narrow third dark band and above a clay, green or greenish-blue in color when moist and with some carbonaceous matter. Below this is a greenish micaceous sand. A considerable seepage of water occurred immediately above the green clay.

DEPOSITS IN THE VICINITY OF THE TYPE LOCALITY AND THEIR BEARING ON THE AGE OF THE BEDS CONTAINING THE HUMAN REMAINS

The section at Locality 2, situated at Mesa Drive, east of Locality 1, so far as this is exposed in the wall of the Haverty trench, does not differ noticeably from that at Locality 1.

At Locality 3 on Ballona Creek near Mesa Drive and approximately three quarters of a mile southeast of Locality 1 an upper sand member rests on a micaceous sandy clay and the contact line apparently marks the water table in this region. Below this occurs a massive bed of peat. At Locality 4 (Vernon Avenue and 11th Avenue) a short distance east of the Ballona Creek locality, narrow bands of peat are present below a stratum of gray sand. These are followed below by dark carbonaceous sands and gray sands. This portion of the section lies above, and is apparently conformable with, gravelly sand.

No great differences in elevation are noted when the three stations (Localities 1, 3 and 4) are compared. It does not appear unlikely, in view of the

relatively short distances that separate these localities, that portions of the sections containing peat at Localities 3 and 4 represent the same period of accumulation as that recorded by at least a portion of the deposits at the human locality. It seems premature, however, to state definitely that the dark carbonaceous sand horizons noted at the human localitity (Locality 1) are the equivalent of the peat beds at Localities 3 and 4. There remains the possibility that these bands represent a later accumulation. More information is needed concerning the beds that underlie the deposits containing the human remains. Undoubtedly, further trenching of the region, as the installation of the outfall sewer progresses, will throw light on this relationship.

At Locality 5, east of the Inglewood Fault and perhaps a mile or more west of Locality 1, a splendid exposure is seen in the sewer trench (Section 10), having a depth of 24 feet. Near the bottom of the trench are exposed clays of Upper Pliocene age, containing marine shells. These deposits have a northeasterly dip and are overlain unconformably by a heavy boulder bed, consisting of granitic materials. Some of the boulders exceed a foot in diameter. Toward the top of the bed are found arkosic sands and large boulders. The accumulation shows decided cross-breeding in places and is undoubtedly of fluviatile origin. Above the boulder bed is a greenish clay with upright stems of plants, and above this is peat. This deposit appears to rest unconformably upon the boulder bed. Laterally the peat may grade into carbonaceous earth.

At Locality 6, just north of Locality 5, a tibia presumably of a camel was found in the course of the excavation for a temporary sewer. This specimen, now in the collections of the Los Angeles Museum, was found over a year ago. It is reported to have come from a depth of 18 feet, although no definite information is now available regarding its position. It is possible that the specimen occurred distinctly higher in the section. A small amount of material in which the tibia was imbedded still adheres to the bone and suggests that the specimen occurred in an arkosic sand. The section at Locality 6 below the capping of soil consists of peat and peaty earth to a depth of 9½ feet. Pockets of shells, comparable to those found at Locality 1, occur in this material. Below this peaty earth is a greenish, micaceous sandy clay with numerous stems or roots, some of which extend downward from the peat beds into the sandy clay. A fragmentary toe bone of a horse was found in this deposit. The sandy clay is three feet thick and is underlain by arkosic sand. The exact relationship of the arkosic material to the sandy clay was not determined. It should be noted from this description that the section at Locality 6 closely resembles that at Locality 5.

The tibia is similar to but not identical with the tibia of the large camel, *Camelops hesternus* (Leidy), of Rancho La Brea. The specimen does not show the type of preservation exhibited by the human remains. If the specimen came originally from the arkosic sand associated with the boulder bed, it suggests Pleistocene age for the latter deposit.

In the Baldwin Hills immediately to the south occur clays and sands containing marine shells indicating Upper Pliocene age. Gravels and sands, referred to the San Pedro Pleistocene, are also present. The pebbles in the gravel beds are usually small, frequently possess ferruginous stains, and do not consist exclusively of granitic rocks. It is evident that there is no deposit exposed in the Baldwin Hills comparable to that of the boulder bed. The latter deposit presumably accumulated after the deposition of these San Pedro beds and, therefore, is at least later than a portion of San Pedro time. It would be of much interest to determine, if possible, the stage or stages of the Pleistocene represented by the deposits exposed in the Baldwin Hills.

The source of the material constituting the boulder bed was presumably in the western part of the Santa Monica Mountains or in the San Gabriel Range. It does not appear likely that the accumulation could have been formed under present climatic conditions by such a stream as the Los Angeles River even if we grant greater carrying power in flood seasons and a course through this region rather than its present course. The course of the old Los Angeles River is still very obscure.

If we concede the Pleistocene age of the boulder bed based on the evidence cited above, then the peat and peaty earth are later, perhaps distinctly later, at least at Localities 5 and 6. Should the deposits underlying the beds containing the human remains prove to be the equivalent of the peat beds, then these deposits are also later than the latest Pleistocene accumulation recorded in that region.

A second possibility presents itself if we regard the deposits exposed at the human locality or a portion of these deposits as having accumulated in ponded waters on the flood plains of the stream responsible for the deposition of the boulder bed. The materials in which the human remains occur and those above this horizon resemble, however, more closely in their lithologic characters the argillaceous sands, carbonaceous sands, and peat at Localities 5 and 6 than they resemble the boulder bed and associated arkosic materials. Undoubtedly the trenching now in progress between Localities 5 and 1 will furnish valuable information bearing on the problem of the relationship of the boulder bed and overlying sands and peat to the deposits in which the human remains were collected.

Lastly, it should be noted that the latest deposit in the immediate vicinity of the human locality is the

material constituting the very small alluvial fans in front of the gullies incising the northern front of the Baldwin Hills.

CONCLUSION

It is apparent from a preliminary investigation of the occurrence of the recently discovered human remains in Los Angeles that the evidence at present available does not point unequivocally to Pleistocene age of the deposits containing the human material. The fact should be emphasized, however, that the sequence of physical events and of faunal changes in the Pleistocene of California requires much careful investigation before a stage of understanding is reached comparable to that represented by Pleistocene history as now recorded in the region east of the Rocky Mountains.

Extensive trenching of the western region of Los Angeles now in progress should result in fuller knowledge of the geological events recorded in the area under consideration, and should establish more definitely the relationship of the Pleistocene deposits and faunas to those of the Recent. While the present report has not shown that the deposits containing the human remains are old in the sense that they belong to a geological period antedating the Recent period, the age of these beds and of the human remains might well be measured in terms of thousands of years, but not necessarily tens of thousands.

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"ANALYZED SOUND" IN NATURE

THE following is an account of an interesting group of phenomena, fundamentally alike, which have been noticed and described independently by five different observers, including myself. Comparing notes with one of these, Dr. Edward W. Emerson, resulted in his suggesting that I should put a description of his observations and mine together in an article, including also the description of two similar observations left with him by his uncle, Dr. Charles Thomas Jackson.[1] Soon after this conversation still another observation of a similar nature was made by Mr. Raymond Emerson, Dr. Emerson's son, and I am fortunate in being able to include a description of this which he has kindly furnished me. Still more recently Mr. W. Rodman Peabody has told me of another instnace of the same sort of phenomenon.

I can best place the data before the reader by simply giving the descriptions of these observations exactly as they were furnished me, and in the case of my own observation, as I wrote it down soon after I made it.

ANALYZED SOUNDS[2]

While engaged in the geological survey of Maine, I had occasion to make a trip through the forests from Farmington to Saddleback Mountain—and, after passing over a hill, we suddenly came in view of Saddleback between which and our party lay a large dismal swamp with a lake in the midst of it. The huge mountain range covered with snow stretched away for a great distance and presented so magnificent a sight as to call forth a shout from my party. The echo, after some moments, came back in musical tones, though the shout was anything but musical.

A fierce Indian war whoop was returned to us in the softest musical tones, not one of the discords being heard.

A gun was fired and the report came back in a *feu de joie* of long continuance and decidedly musical in its effect. Very discordant yells were made to try the effect, but only musical tones were returned. These interesting acoustic experiments were repeated for a long time with much amusement to the party—to me the matter seemed full of meaning—and was a subject of much reflexion.

While engaged in the earliest mining researches on Lake Superior, in 1844, a very curious instance of analyzed sounds was observed by F. W. Davis and myself—I had been sick and in consequence remained at the log cabin we had erected at Eagle Harbor on Keweenaw Point and sent out our miners to open a mine at Eagle River eight miles distant. Davis and myself set out one day to shoot some pigeons and while wandering not far from the shore in the cedar swamp near the harbor, we both suddenly stopped and listened to a sound which had reached our ears.

It was a melodious and solemn dirge in slow music like that I have sometimes heard in European cathedrals.

We listened for some moments before speaking, wondering where this music could come from. At first we thought it might be that our party of miners were returning and were chanting in the forest. To ascertain if such was the case, we ran in the direction the sound appeared to come from but in a short time we lost it. We then went down to the lake shore and looked up and down the coast from the point, but there was no boat and not a human being to be seen and no music was heard.

On returning to the spot where we first heard it, it was still heard there, but moving a few hundred yards either way, we lost it again. Much puzzled with this strange music of the woods, we returned to our cabin and found that old Jacob, our cook, was then engaged in his operations of making bread and had not been out of the cabin and had not been singing—indeed, he was no musician.

[1] Dr. Jackson was the geologist and chemist whose observation in 1842, of ether anesthesia, induced in himself, led to the introduction of this practice into surgery by Morton in 1846.

[2] From the notes of Dr. Charles Thomas Jackson, chemist and geologist.

To account for these musical tones, I supposed it was a case of analyzed sounds and on comparing the measure, I found that it corresponded to the rote of the waves on the pebbly shore. The vibration of the air produced by the constantly recurring surges was analyzed by the forest and we stood where we heard it in a focus of the echo. Similar phenomena were noticed by the late Francis C. Gray, Esquire, at the Picture Rocks on the north shore of the lake, music like that of a deep-toned organ coming from the pulpit rock, an inaccessible cliff of sandstone.

Thus it appears that when sounds mingled with discords traverse the forest, the foliage absorbs all the discordant notes and the reflected and returned sounds are all pure liquid harmonies.[3]

Is not this also a representation of human history? In the lapses of time the errors and wrongs of the past are lost and only the soft and pure music of truth is reflected back in the distant future—only the heroic and that worth preserving remain and errors are eliminated from the biography of men—and the good they have done lives after them.

Fear not then that any good you have done will be lost, or that malice and envy will poison the history of your good deeds. Time will, with its analytic prongs, separate, absorb and extinguish all the evil that has troubled the present and will fill the future with the harmonies of your noble actions and generous sacrifices.

"THE MUSIC OF NATURE"[4]

In 1862, July, when I was journeying westward with an emigrant train on the California trail, we rested in camp one Sunday to recruit the horses and mules. It was on the North Branch of the broad River Platte not far from Fort Laramie nearing the foot-hills of the Rocky Mountains. We were, therefore, at a considerable altitude. The air was fine and dry, the country an alluvial plain covered with grass, bounding the course of the river which, shallow and shifting, spread its broad waters, yellow and turbid with fine sand, over much country, even in summer. I was tired of the talk of the dozen or two of men, women and children, but the rare sight of a grove which had escaped the prairie fires attracted me. I walked alone into this group of large cotton-wood trees. These and the fringe of dwarf-willows along the stream attracted me after riding and walking for continuous weeks over treeless green plain. I left my mates for the restful solitude that the trees offered. As soon as I arrived there I was surprised by music strangely sounding in the direction of our camp. Yet whence did it come? When I reached camp, and asked whence, no one understood what I was talking about. There had been no music. Every one about camp was quite otherwise employed and no practical joker was about. Some years after, my mother's brother, Dr. Charles Thomas Jackson, surveying in Maine, had a similar experience, finding that at a certain distance his voice would carry in either direction with great distinctness, while nearer, perhaps in each direction, was silence.

The following account was furnished by Mr. Raymond Emerson in a letter dated May 13, 1922:

I was on a gasoline tug boat coming up the Slave and Athabasca rivers in Alberta, Canada, last September from Ft. Fitzgerald and Ft. McMurray. There was a strong current from 3 to 4 miles per hour running, and our boat consequently kept pretty close in shore to take advantage of all the eddies at the bends of the river. The shores were heavily wooded with spruce, jack pine, birch and poplar, and there were many stretches of several miles where the trees had been killed by fire. The tug was pushing a loaded scow and the exhausts of her engines were loud and rather sharp. The sound of these exhausts echoed back clearly from the high banks, but where the banks were low the echo was apparently broken up and came back as a musical rhythmical sound very much like the thrumming noise produced by a person striking the strings of a large harp. This sound was very noticeable and attracted the attention of all the men on both scow and tug. As soon as my attention was drawn to this musical sound I watched carefully to see how it varied with our distance from the shore, etc., and the result of my observation was that whenever we approached a part of the river with low banks and with a heavy growth of fire-killed trees, the sound became more musical, and its resemblance to the sound produced by a harp increased, where the trees were green it was less apparent, and where the banks were high and the boat close under them the musical quality was lacking and the echo came back clear and sharp—a true reflection of the report of the exhaust. The only explanation that occurred to me was that the sound waves were broken up by striking against the dead trees, which of course did not present a uniform reflecting surface; but each tree reflected a part of the sound, and this reflection was broken up into innumerable parts on account of the varying element of distance. When the boat moved a hundred yards or more out into the stream the musical effect decreased and disappeared entirely when we were over 200 or 300 yards away. I should add to the statement that both rivers have an average width of well over a mile, so that whatever echo we had came from the nearer bank only.

My own observation follows.

A SOUND WAVE PRISM

On July 27, 1903, while on a journey through the Bighorn Canyon in Southern Montana by boat, I set out in the morning from our camp at the mouth of the Bull Elk Creek to walk down stream along the right bank of the river, accompanied only by my dog. As I was walking down one of the sandy beaches on the river's edge I heard a howl, beginning at a high pitch and sweeping down into the bass clef. I stopped short and looked around; I could hear nothing but the roar

[3] Dr. Jackson told R. W. E. that this phenomena had never been treated scientifically except in a paper by Dr. Wollaston, and he called it "Analyzed Sound" E. W. E.

[4] Early experience of Edward W. Emerson.

of the river. I took a step backward and the howl reversed itself, starting low and rising to a high pitch. I then moved back and forth over the same ground and found the noise to be no more than the roar of the river, rising and falling like a siren. It seems the rocks around me formed a sort of sounding-board, treating the roar as a prism treats sunlight, placing the tones according to their pitch, the high in one place and the low in another.

I have no doubt the observation could be repeated if the exact spot were revisited at approximately the same time of year, *i.e.*, when the river was at the same height. As nearly as I can recall, the spot was only a few yards (probably five or ten) from the water's edge, and probably not more than a mile down stream from Bull Elk Creek.

Within a few days Mr. W. Rodman Peabody has described to me an interesting case of this phenomenon which he experienced some years ago.

He was travelling with a pack train in the Canadian Rocky Mountains. Some other members of the party had left the pack train in the morning and set out on foot on an all day hunting excursion. Late in the afternoon Mr. Peabody left the pack train at a convenient camping place and set out on foot to find the hunting party at a designated rèndezvous where two streams met. He was scrambling down a steep ravine into the canyon where he expected to find the others, when at a point about a hundred yards from a mountain torrent he heard clearly what he took to be a man's voice. He said to himself, "That's W. trying to sing. It's out of tune; so it must be W." The point where he heard it was surrounded by coniferous trees. As he went on, the sound disappeared, but so sure was he that it had been his friend's voice that he fully expected to see him when he emerged from the woods a few yards farther on. To his surprise there was no one in sight. He searched for them till dusk, and then scrambled back up the ravine to the pack train. On his return he heard exactly the same sound as he traversed the place where he had heard it before.

He described it to the guides, and they said they had heard the Indians speak of hearing such things in the mountains, although they had not themselves experienced it. Mr. Peabody concluded that if these guides, although spending their lives outdoors in the mountains, had never noticed this striking phenomenon, it must be of rare occurrence.

Dr. Emerson, in sending the above descriptions, called attention to a passage in the poem entitled "May Day" by his father, R. W. Emerson, which clearly was suggested in part by the observations of Dr. Jackson.

> None can tell how sweet,
> How virtuous, the morning air;
> Every accent vibrates well;
> Not alone the wood-bird's call,
> Or shouting boys that chase their ball,
> Pass the height of minstrel skill,
> But the ploughman's thoughtless cry,
> Lowing oxen, sheep that bleat,
> And the joiner's hammer-beat,
> Softened are above their will,
> Take tones from groves they wandered through
> Or flutes which passing angels blew.
> All grating discords melt,
> No dissonant note is dealt,
> And though thy voice be shrill
> Like rasping file on steel,
> Such is the temper of the air,
> Echo waits with art and care,
> And will the faults of song repair.
> So by remote Superior Lake,
> And by resounding Mackinac,
> When northern storms the forest shake,
> And billows on the long beach break,
> The artful Air will separate
> Note by note all sounds that grate,
> Smothering in her ample breast
> All but godlike words,
> Reporting to the happy ear
> Only purified accords.
> Strangely wrought from barking waves,
> Soft music daunts the Indian braves,—
> Convent-chanting which the child
> Hears pealing from the panther's cave
> And the impenetrable wild.

In Volume IX of the Centenary Edition of the complete works of R. W. Emerson, there appears an explanatory note (inserted by Dr. Emerson) referring to this passage in the poem, and giving a condensed statement of his own observation and those of Dr. Jackson, which shows the origin of the idea expressed in the poem. In this note Dr. Emerson mentions waves breaking on the shore of the river as the source of the sound in his own observation.

All the phenomena described above seem to be instances of differential reflection or absorption of sound waves of different pitches. In every case the source of the sound—waves on a beach, roar of a river, exhaust of motor boat or discordant human voice—was one in which many pitches were present. Something in the surroundings, usually trees, must have separated the sounds according to pitch, placing those of one pitch in one place and those of another pitch elsewhere. In this respect the phenomenon appears analogous to that of white light being broken up into pure spectral colors by a prism or diffraction grating. In the original description of my own observation I made no mention of trees. As I recall it, the place where I heard the "howl" was an open one, but there were scattering trees not far away. It is interesting that this phenomenon has been noted in such a variety of natural conditions.

ALEXANDER FORBES

HARVARD MEDICAL SCHOOL

SCIENTIFIC EVENTS

PITTSBURGH TRAINING SCHOOL'S LECTURE COURSE ON SCIENCE AND EDUCATION

The Pittsburgh Training School for Teachers is an institution under the direct control of the Board of Public Education. In 1921 the Alumnae of the Training School, under the direction of Dr. H. B. Davis, principal of the school, established an annual course of lectures on the scientific aspects of education. The thought of the organization was that such a contribution to the intellectual life of the city would be a more significant expression of its real and vital interests than the usual round of social affairs. These lectures are free to the public and have usually filled the lecture hall of the Carnegie Central Library with an average audience of six hundred.

In the establishment of the course it was primarily conceded that, if there is a science of education, then original investigators ought to be able to give light on the subject, but, if there should prove to be no such science, then we ought to cease talking about it. The lecturers who have thus far appeared, together with their subjects, are as follows:

Season of 1921

The significance of intelligence levels in a democracy: H. H. Goddard, Columbus, Ohio.

Experimental studies in the emotional life of children: John B. Watson, New York City.

Psychoanalysis in the light of modern psychiatry: Adolph Meyer, Johns Hopkins University.

The relation of heredity to education: Herbert S. Jennings, Johns Hopkins University.

Season of 1922

The problem of the nervous child: Charles Macfie Campbell, Harvard University.

The effect of emotions on the body: Walter B. Cannon, Harvard University.

Psychology and Science: Edward B. Titchener, Cornell University.

The rôle of education in race development: Edwin Grant Conklin, Princeton University.

Season of 1923

Do types of growth determine mind?: Charles R. Stockard, Cornell Medical School, New York City.

The new psychology and the teacher: Thomas W. Salmon, Columbia University.

The population problem: Raymond Pearl, Johns Hopkins University.

Some human inadequacies and their relation to the internal glandular system: Walter Timme, New York City.

This course of lectures has already earned the reputation of offering the most evident results of scientific investigation that the city of Pittsburgh affords.

H. B. Davis

Pittsburgh Training School for Teachers

BARRO COLORADO ISLAND BIOLOGICAL STATION

As recently noted in Science, the biological station on Barro Colorado Island in Gatun Lake (Panama Canal), which has been developed by the Institute for Research in Tropical America, with the cooperation of the division of biology and agriculture of the National Research Council, now has laboratory and housing quarters sufficient for a limited number of workers. Such workers enjoy certain commissary privileges and may receive material assistance in going to and returning from the Canal by means of a limited number of steamer passes generously provided by the United Fruit Company, and by transportation on army transports just authorized by special order of the Secretary of War. By this order scientific workers furnished with proper credentials from the chairman of the executive committee of the Institute for Tropical Research will be carried on government transports when space permits. Not more than four applicants may be scheduled for any one transport. These transports usually leave New York between the 5th and 8th of each month and San Francisco between the 8th and 11th of each month.

Arrangements have already been made by several scientific men to work at the station this summer, but a few more can be accommodated. In the absence from Washington of Dr. David Fairchild, Dr. Thomas Barbour is acting chairman of the executive committie of the Institute for Research in Tropical America, and inquiries should be addressed to him, either at the Museum of Comparative Zoology, Cambridge, Massachusetts, or in care of the Division of Biology and Agriculture, National Research Council, Washington, D. C.

Vernon Kellogg,
Permanent Secretary,

National Research Council

THE THIRD PAN-AMERICAN SCIENTIFIC CONGRESS

On December 20, the third Pan-American Scientific Congress will assemble at Lima, Peru, and will continue in session for two weeks. The organizing committee is now actively engaged in making arrangements for the congress, and cooperating committees in the different republics of the American continent are also engaged in arousing interest among the scientific and educational institutions of the respective countries in the forthcoming meeting.

Prior to 1908 congresses of a scientific character had been held at irregular intervals at which only representatives of the Latin-American republics were present, but in that year the first Pan-American scientific congress assembled at Santiago, Chile, at which nineteen republics, including the United States, were represented. The second congress was held at Washington in 1915–16, at which delegates from all the American republics were in attendance.

The scientific congresses have been instrumental in bringing together the leaders of scientific and educational thought of the republics of the American continent. The interchange of views and opinions which takes place at these meetings and the contacts established between the scientists and educators of the American republics are of great importance in the development of closer cultural and economic ties between the countries of the western hemisphere.

Reports received from Lima indicate that the forthcoming congress will be fully as important as its two predecessors. At the meeting held at Santiago, in 1908, ten associations and institutions of the United States sent delegates to the congress and in all probability as large a delegation will go to Lima in December.

The work of the congress will be sub-divided into sections devoted to anthropology and history; physics and mathematics; mining, metallurgy and applied chemistry; engineering; medicine and sanitation; biology and agriculture; private, public and international law; economics and sociology, and education.

GEOLOGY AT THE TORONTO MEETING OF THE BRITISH ASSOCIATION

AMONG overseas geologists who will be present at the Toronto meeting of the British Association are the following:

President of Section C—W. W. Watts, D.Sc., LL.D., F.R.S., professor of geology, Imperial College of Science and Technology and foreign secretary of the Mineralogical Society, London. Will speak on some phase of economic geology.

Vice-President—Gertrude Elles, D.Sc., Newnham College, Cambridge, former president of Section C, Liverpool meeting.

Recorder—W. T. Gordon, M.A., D.Sc., F.G.S., professor of geology, King's College, London.

F. A. Bather, M.A., D.Sc., F.G.S., F.R.S., head of the department of geology, British Museum.

P. G. H. Boswell, O.B.E., D.Sc., F.R.S., professor of geology in the University of Liverpool.

Arthur Hubert Cox, professor of geology in University College, Cardiff.

J. S. Flett, O.B.E., M.A., D.Sc., F.R.S., director of the geological survey of Great Britain and the Museum of Practical Geology.

H. L. Hawkins, D.Sc., F.G.S., professor of geology, University College, Reading.

G. Hickling, D.Sc., F.G.S., professor of geology and botany, Armstrong College, Newcastle-on-Tyne.

Sir Thomas Holland, F.G.S., F.R.S., rector of the Imperial College of Science, London. Delivers one of the evening discourses, during the meeting, on the subject, "The formation and destruction of mineral deposits."

Owen Thomas Jones, D.Sc., professor of geology in the University of Manchester; formerly of the geological survey of Great Britain.

Sidney Hugh Reynolds, Sc.D., professor of geology in the University of Bristol.

William Johnson Sollas, D.Sc., F.R.S., professor of geology and paleontology in the University of Oxford, and ex-president of the geological society of London.

L. J. Spencer, D.Sc., of the British Museum (Natural History), editor of *Transactions* of the mineralogical society of London.

W. B. Wright, of the Manchester branch of the geological survey of England.

GIFTS TO HARVARD UNIVERSITY

SUPPLEMENTING the report of Bishop Lawrence made to the alumni of Harvard at their annual meeting in which gifts of $9,289,595 to the university were announced, gifts which had come as the result of the university's drive to add to its equipment, President Lowell has announced other bequests to the university amounting to $5,158,000. These include:

An anonymous gift of $50,000 for the Arnold Arboretum.

From the same donor to found a George Lincoln Goodale Fund in memory of Professor Goodale, to be used for the current expenses of the Botanical Museum, making from that donor $100,000.

From the estate of William Brewster, $60,000, three quarters of it to be used for the payment of the salary of a competent ornithologist and the remainder for the renewal and repair of cases of birds in the museum.

From the estate of Harry Butler, $100,000.

From the Class of 1903, on account of its 25th Anniversary Fund in the future, $34,500.

From the estate of Joseph R. DeLamar for the Medical School (an additional) $100,000.

From the General Education Board for the Medical School for the endowment of the department of psychiatry and neuropathology, $386,000.

From the estate of A. Paul Keith, unrestricted (an additional) $1,964,000.

From Mr. and Mrs. George A. McKinlock toward the dormitory to be named in memory of their son, George A. McKinlock, Jr. (additional) $55,000.

From the estate of Hiram F. Mills for investigation of cancer, $103,000.

From the estate of William F. Milton $1,030,000.

From Miss Susan Minns, the income to be used for the Botanical Museum, $50,000.

A bequest from Mrs. Lewis H. Plympton, $50,000.

From the Rockefeller Foundation for the School of Public Health, $118,000.

From the estate of Miss Annie Blake Shaw, a bequest to found the Samuel Parkman Shaw Fund for loans or gifts to deserving undergraduates, $50,000.

From Galen L. Stone for purchase of the Bruce collections of Chinese paintings for the Fogg Museum, $30,000.

From the estate of Morrill Wyman for the Medical School (an additional) almost $40,000.

Other gifts, $784,000.

SCIENTIFIC NOTES AND NEWS

Dr. Elihu Thomson, one of the founders of the General Electric Company and director of the company's research laboratory at its Lynn works, will receive two honors in England in July. The University of Manchester will confer the honorary degree of doctor of science upon him July 4, and on July 10 he will receive the Lord Kelvin gold medal in London. Professor Thomson is the first American to receive this honor.

The Belgian Order of Leopold has been bestowed by King Albert on Dr. Leo Hendrik Baekeland, president of the American Chemical Society, and professor of chemical engineering at Columbia University.

At the meeting of the American Medical Association in Chicago, Dr. William D. Haggard, professor of surgery in Vanderbilt University, was elected to the presidency for the coming year.

Dr. George Grant MacCurdy, curator of anthropology in Yale University, has been appointed research associate in prehistoric archeology at the university, with professorial rank.

Professor Boris Weinberg has recently been appointed director of the Central Physical Observatory at Leningrad (formerly Petrograd).

The council for the American Physiological Association has awarded the Porter fellowship for this year to Dr. Raymond Hausler, instructor in anatomy at the University of Oregon Medical School. Dr. Hausler will work in Professor A. J. Carlson's laboratory at the University of Chicago.

Dr. Norman Comber has been elected to the chair of agricultural chemistry at the University of Leeds, England, in succession to Professor C. Crowther, who is now principal of the Harper Adams Agricultural College.

Dr. Frederick G. Banting, of the University of Toronto and discoverer of insulin, received the honorary degrees of doctor of laws and doctor of science from the University of Chicago, the degree of doctor of science from Yale University and the degree of doctor of laws from the Western University of Medicine, Ontario.

Professor John Merle Coulter, head of the department of botany at the University of Chicago, received the honorary degree of doctor of science at the June commencement of Lake Forest University.

The University of Pittsburgh conferred at its recent commencement the degree of LL.D. on Dr. William James Mayo, chief of staff of the Mayo Clinic, Rochester, Minnesota, who gave the commencement address; the degree of Sc.D. on Douglas Stewart, director of the Carnegie Museum, Pittsburgh, and the degree of Pharm.D. on Edwin Leigh Newcomb, professor of botany in the University of Minnesota.

At the meeting of the Royal Astronomical Society on June 13 the gold medal of the society was presented to Professor A. S. Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge.

The Royal Anthropological Institute has founded a Rivers memorial in memory of Dr. W. H. R. Rivers, who was president of the institute at the time of his death. The medal will be awarded for special meritorious anthropological work in the field. All British subjects and anthropologists of other nations who are fellows of the institute will be eligible.

The gold medal of the British Medical Association has been awarded to Dr. Henry B. Brackenbury for services to the association and the medical profession.

Alexander G. McAdie, professor of meteorology at Harvard University and director of the Blue Hill Observatory, has been elected a member of the international cloud committee.

Dr. F. H. McMechan, secretary general of the American Society of Anesthetists, has been chosen first American honorary member of the section of anesthetists of the Royal Society of Medicine of England.

Dr. W. A. Murrill, supervisor of public instruction at the New York Botanical Garden, has returned from his expedition to South America, where he made stops in Argentina, Uruguay, Brazil and British Guiana.

Neil M. Judd, curator of American archeology, National Museum, left Washington on May 16 to resume direction of the explorations of the National Geographical Society at Pueblo Bonito. This prehistoric ruin, one of the largest and most important in the southwestern United States, is the most famous unit of the Chaco Canyon National Monument. The society began its explorations in Pueblo Bonito in 1921; it is hoped that the work will be concluded by the end of 1925.

Professor Julius Stieglitz, chairman of the department of chemistry at the University of Chicago,

recently gave at Johns Hopkins University a series of lectures on the Charles E. Dohme memorial foundation, his general subject being "Chemistry and recent progress in medicine."

CHARLES A. KOFOID, professor of zoology at the University of California, delivered the commencement address at the University of Washington.

JOHN L. BEAR, an anthropologist of the Smithsonian Institution and a member of the faculty of George Washington University, died on May 28 in Southeastern Panama, where he had gone as a scientific member of the Marsh expedition, which left New York in January to study the so-called "white Indians" of Darien.

DR. BEVERLY ROBINSON, formerly professor of clinical medicine at Bellevue Medical College, New York, died on June 20, aged eighty years.

THE death is announced of Kenneth Mackenzie, reader in agriculture at Cambridge University, late director of the university farm and consultant to the Institute of Animal Nutrition, at the age of fifty-one years.

DR. ROBERT KENNEDY, St. Mungo professor of surgery in the University of Glasgow since 1911, died on June 3, at the age of fifty-eight years.

DR. S. GABRIEL, honorary professor of chemistry in the University of Berlin, has died at the age of seventy-three years.

DR. RICHARD PALTAUF, director of the Institute of General and Experimental Pathology in Vienna and a well-known writer on the pathology of the blood and diseases of metabolism, has recently died at the age of sixty-seven years.

THE London Mathematical Society recently elected as honorary members the following: L. Bianchi, A. Einstein, J. Hadamard, E. Landau, H. Lebesgue, T. Levi-Civita, L. Prandl and A. Sommerfeld. Four of these eight new honorary members are professors in German universities. The other four are equally divided among the French and the Italian universities.

THE American section of the International Mathematical Union has elected the following delegates to represent the United States at a meeting of the union in Toronto, August, 1924: Professors A. B. Coble, L. P. Eisenhart, E. V. Huntington, R. G. D. Richardson, H. L. Rietz and Virgil Snyder.

AT the April meeting of the Royal Society of Western Australia a proposal was brought forward by the council to institute a gold medal to be awarded from time to time for distinguished and pioneer work in connection with science in the state. The celebration in June of the centenary of the birth of Lord Kelvin was thought a fitting occasion for the inauguration of this new award. The scheme was approved by the society, and the further proposal was adopted that the first award should be made to W. J. Hancock, D.Sc., for his work in connection with radiography. Dr. Hancock was a pioneer in X-ray work in western Australia, and during a period of 22 years he acted as honorary radiographer for the medical department, the Perth Hospital and the Military Base Hospital, Fremantle.

THE General Electric Company is arranging for a conference of college professors to be held at its Schenectady works from July 7 to August 9. It is the plan to have each physicist spend the greater part of his time in the department in which the work most closely coincides with his interests. Twice a week visits of inspection will be made throughout the plant, followed by round-table conferences with General Electric engineers.

McGILL UNIVERSITY has received $650,000 from the Rockefeller Foundation for the establishment of a school of public health in connection with the faculty of medicine. The gift will permit of the extension of the department of hygiene and the public health, nursing and Connaught laboratories, which are dealing with the manufacture of insulin.

CAMBRIDGE UNIVERSITY has received from Sir Jeremiah Colman, of St. John's College, the sum of £2,000 for a library for the school of biochemistry.

THE Canadian manufacturers' association has approved the creation of a national institute of scientific research for the Dominion. A fund of $1,000,000 is to be raised.

THE National Association of Audubon Societies has received as a gift from Mrs. Grace Rogers, sister of the late Paul J. Rainey, hunter and explorer, a tract of more than 26,000 acres of marsh lands for a bird sanctuary in Vermilion Parish, Louisiana.

THE committee on scientific research of the American Medical Association has granted to Dr. Herbert M. Evans, of the University of California, $400 for his work on the anterior hypophyseal hormone.

THE American Roentgen Ray Society has offered a prize of $1,000 to the author of the best piece of original research in the field of the roentgen ray, radium or radioactivity. The competition is open to any one living in the United States or its possessions or elsewhere in the western hemisphere. Work submitted for the prize carries with it the understanding that the subject-matter will remain open to free use for the public good. The prize is offered for the promotion of useful research with the approval of the National Research Council, and to commemorate the name of Dr. Charles Lester Leonard, who was a martyr to the roentgen ray.

At a meeting on June 3, 1924, the board of directors of the Agricultural and Mechanical College of Texas authorized the establishment of a graduate school and a school of arts and sciences, the latter to be coordinated with the existing schools of agriculture, engineering, veterinary medicine and vocational teaching. Dr. Charles Puryear, for many years dean of the college, was appointed dean of the graduate school, and Charles E. Friley, registrar and secretary of the general faculty, was appointed dean of the school of arts and sciences.

The St. Mary's Group of Hospitals, comprising six hundred beds, has by agreement become the university hospital of the St. Louis University School of Medicine, the university having full control of the medical and educational activities. The first step in the complete establishment of this relationship has been the organization of the department of medicine on a full-time basis. In addition to the instructors who have been previously conducting the department, the following full-time men have been appointed: Ralph A. Kinsella, professor of medicine and director of the department, formerly associate professor at Washington University; Goronwy O. Broun, associate professor of medicine, formerly instructor of medicine at Harvard University; Charles H. Hitchcock, assistant professor of medicine; Alfred P. Briggs and Octavio Garcia, instructors in medicine.

Following the program prepared by the colloid committee of the National Research Council, the second National Colloid Symposium was held in Evanston, Ill., June 18 to 20. More than 250 registered and participated in the social and scientific activities, which included attendance at the June 20 meeting of the Chicago Section of the American Chemical Society. Harry N. Holmes and Ross A. Gortner presided at the symposium meetings.

According to *Nature*, the National Union of Scientific Workers of England has issued a strongly worded circular against the perpetuation of international passions raised by the war by the continued existence of the so-called International Scientific Unions founded in 1919 by the International Research Council and managed by an executive committee of which Sir Arthur Schuster is general secretary. The National Union points out that the council exists not to promote international cooperation but to exclude ex-enemy nations and maintains that it is the desire of the majority of scientific men in Great Britain to ignore the unions so established. It instances the recent genuinely international physiological congress at Edinburgh and psychological congress at Oxford as signs of the growing opposition to the policy of the Research Council.

Research plans are now being formulated in the Forest Service for the establishment of a forest experiment station in the Pacific Northwest to handle the forestry problems of Washington and Oregon. The more pressing problems of the Pacific Northwest have to do with the growth, management and protection of the Douglas fir and coastal forest types, as well as with the management of the yellow pine forests on the eastern side of the Cascade range. This new station will be on a par with those established a year ago in the Lake States and the northeastern forest regions. Plans are also under way for a material enlargement of the forest research work in the southern pine region. The work in the south has been under way for three years, but this year, due to an increase in the appropriation given the Forest Service for research, it will be possible to make this station the largest of all the experiment stations the Forest Service is now operating. The problems of the southern pine region are those involved in the production of naval stores, the proper forest management of the southern pine forest, the rate of growth of young trees following cutting, the establishment of reproduction and the influence of fire upon rate of growth.

The faculty of applied science, having in charge the Schools of Mines, Engineering and Chemistry of Columbia University, has introduced important new courses into the program of study and has established closer cooperation with the Columbia University School of Business in municipal engineering. Cooperation has also been brought about with the National Institute of Public Administration, formerly the Bureau of Mining Research. Students in the Columbia University civil engineering course will be able to take advantage of the opportunities offered by the National Institute of Public Administration in courses for the training of the modern city manager.

UNIVERSITY AND EDUCATIONAL NOTES

Gifts and pledges totaling $2,719,000 for buildings and endowment funds, made to Yale University during the university year 1923–24, were announced at the commencement exercises. In addition gifts of Yale alumni to the university this year reached a total of nearly half a million dollars.

Professor Mark E. Penny, of the school of education at Ohio State University, has been elected president of James Millikin University.

Dr. A. Ross Hill, of Kansas City, formerly president of the University of Missouri, has been elected president of the University of Oklahoma.

Dr. Harold Albert Wilson, professor of physics in the Rice Institute, Texas, has been appointed to the chair of natural philosophy in Glasgow University.

George C. Fracker, dean and head of the depart-

ment of psychology at the University of Dubuque, has been appointed professor of psychology and philosophy at the University of Arkansas.

DR. ASA A. SCHAEFFER, of Clark University, has been appointed professor of zoology at the University of Kansas.

R. C. RICHARDS, formerly of Trinity College, Cambridge, and fellow of the Institute of Physics, has been appointed Quain lecturer in physics at University College, London.

DR. HENRY BLUMBERG, professor of mathematics at the University of Illinois, is to be on leave of absence during the academic year 1924–25.

HERBERT A. ROGERS, research assistant professor at the University of Minnesota, will be associate professor of psychology at the University of Vermont next year.

DR. WALTER C. KRAATZ, now acting professor of zoology at Miami University, has been elected to the position of assistant professor of biology at the University of Akron.

DR. BRUCE HOUSTON has been appointed assistant professor of chemistry in the University of Oklahoma.

APPOINTMENTS at Brigham Young University have been made as follows: Dr. Milton Marshall, of the University of Chicago, assistant professor of physics; Dr. Carl F. Eyring, of the California Institute of Technology, dean of the college of arts and sciences, and L. John Nuttall, Jr., director of training schools at the university, dean of the college of education.

DISCUSSION AND CORRESPONDENCE

ON THE PROPER WORDING OF THE TITLES OF SCIENTIFIC PAPERS

WHEN Dr. H. H. Donaldson published, in SCIENCE for February 23, 1917, a note entitled "More complete titles," I was too inexperienced in bibliography to appreciate fully its meaning and value. In this note he specifically suggested that there be included the name of the animal, scientific or common or both, and some indication of the group to which it belonged. However, in June of that same year I began work on Volume III of Dr. Bashford Dean's "Bibliography of Fishes," and in 1919, by reason of the lamented death of the talented Dr. Charles R. Eastman, I became the active editor of that work. The marked feature of Volume III is its elaborate and minutely subdivided subject index, and in my part of this I had not gone very far when the incompleteness and misleading wording of a great number of the titles of ichthyological works became painfully apparent.

As our work here progressed, a series of articles bearing more or less directly upon the subject at hand was published in SCIENCE. In the issue for September 3, 1920, Mr. Neil M. Stevens, of the Bureau of Plant Industry, wrote on "The obligation of the investigator to the library." And in that of September 30 of the same year, Mr. Gordon S. Fulcher, of the Corning Glass Works, discussed "Scientific abstracting," as a great time-saver to the researcher.

More to our purpose, however, was the article of Miss Eunice R. Oberley, librarian of the Bureau of Plant Industry, on "Abstracts and titles of scientific articles from the librarian's standpoint," in SCIENCE for November 18, 1921. In this she made a strong plea for such clear and definite titles as will enable the librarian or bibliographer quickly and accurately to catalogue the article so that the investigator *must* find it in his search for the literature.

Next (SCIENCE, August 25, 1922) came the outstanding article by Mr. W. W. Bishop, formerly superintendent of the reading room of the Library of Congress and at present librarian of the University of Michigan, on "The record of science." In this Mr. Bishop made it very clear that "bibliography is the foundation of research." Later, this article was very effectively commented on by Mr. K. C. Walker in SCIENCE under date of October 13.

And lastly I spoke on the subject before the American Society of Zoologists at Cambridge on December 28, 1922, and published in its Proceedings in the *Anatomical Record* of January, 1923, a short abstract entitled "The proper wording of scientific titles."

These various articles would indicate that the matters of abstracting and bibliography, and the proper wording of titles on which they are vitally dependent, are very much in the minds of librarians and bibliographers. Furthermore, the botanists and zoologists are likewise becoming interested, for the Union of Biological Societies of America is even now considering the founding of an abstract and bibliographical journal.

Volume III of the "Bibliography of Fishes" is now done and has been distributed. The outstanding section of this volume is the Subject Index in which the 45,000 titles in Volumes I and II and in the Addenda in Volume III have been minutely analyzed and then brought together, likes with likes. This has been a prodigious undertaking, but we who have done it believe that we have produced the most efficient tool ever made for the use of ichthyologists, and for librarians and bibliographers seeking certain definite references in fish literature. This has been done at great cost of time, labor and money. The time has been increased by many months, the monetary cost by thousands of dollars, and the labor infinitely by defective

and misleading titles which had to be looked up before they could be properly and accurately located in the subject index. And now because of this hard experience, I am moved to discuss the subject which forms the heading of this article in the strong hope that thereby some authors and some editors may be led to the clarifying of titles to the great benefit of future bibliographers, librarians and researchers.

Scientific articles are written that they may be read, but the people who mage them available to readers are bibliographers and libranians, and their efforts are badly crippled by imperfect, misleading, faulty titles. Classification of these faulty titles is not easy, since in kind and degree of faultiness they intergrade, but in order to make clear their faults the following rough distribution will be used: I, indefinite; II, misleading; III, absurd. Of all these some "horrible examples" will now be considered.

First let us consider some titles which by their indefiniteness befog the inquirer's mind. "An unusual sea monster in the bay" might mean a whale, a crocodile, a giant squid, a great shark or any large tropical bony fish, like the sailfish, which attains a length of 12 or 15 feet, and the bay might be any one of a hundred bays. As a matter of fact the title should have read, "*Rhineodon typus*, the whale shark, in the Bay of Bengal." Again, "Notice of an extraordinary fish" might mean any one of a hundred fishes, whereas it refers to the occurrence of the whale shark in Manila Bay. Like these is "On a singular fish from the South Seas," which as a title is absolutely indefinite and practically meaningless. Such also is "Note sur un embryo monstreux." Is this monstrous embryo mammalian, avian, reptilian, amphibian, piscine or one of a possible thousand invertebrate forms? Scores of other utterly indefinite titles might be quoted, but one more will suffice. An old inaugural dissertation was entitled "De Monocerote," and one does not know whether it refers to the Arctic unicorn, to the swordfish or to the unicorn beetle. Another old writer used the same front title, but put in it in I-II-III-order the three unicorn beasts just referred to.

Under the head of misleading titles the following may be quoted: An author entitled his book "Ancient Angling Authors," and one would conclude that he dealt with all, but examination of his book shows that he confines himself to English writers only. Another very authoritative work bears title "Fishing from the Earliest Times," and one would presume that it brings the subject down to the present, whereas it concludes with 500 A. D. A monograph headed "Studies on Lepidosteus" (a Ganoid) is the most authoritative work on the egg-membranes of Teleosts. Another great monograph is entitled "On the Ovary of Selachii," but examination showed that it had to do with the development of the egg, its follicle, membranes, nucleus, yolk, etc. Another reads, "Notes on the Life History of Illinois Fishes," but examination showed *no* life histories at all but brought to light the best paper yet published on the *breeding habits* of the freshwater fishes of the central states of our republic.

Finally, there is a large series of very important papers by one of the leading authorities of the world bearing the title, "On the anatomy and classification of ——— fishes" or "On the osteology and classification of ——— fishes." When laboriously looked up the "anatomy" almost always turned out to be "osteology" and the "osteology" was generally that of the skull only. It would have been just as easy to have the title say *exactly* what these papers dealt with.

Now we come to the third class—titles which may be called absurd, but which, if the editor would permit, I would like to characterize by a stronger term. The first on my list reads "On Mene rhombeus." What is "Mene rhombeus"? The specific name sounds "fishy" but what is the "On"—anatomy, behavior, coloration, embryology, habits—*what?* Only a trip to the library will answer. The German aquarists are the worst offenders in using such titles, yet many of their papers bearing these titles contain admirable observations on habits. Titles of the absurd class might be given *ad libitum*, but only a few are listed—"On the Australian lamprey," "The mormyrid brain," "An electric ray and its young," "About the perch," "The basking shark," "*Ctenodus cristatus*."

These are sample titles which will make clear some of the difficulties with which we have had to contend in working up the subject index of the "Bibliography of Fishes," and the compilation and publication of Volume III has been delayed for months by the handling of these "left-handed" titles. If such papers were by men of standing, if they were published in reputable journals, if their size indicated that they ought to contain valuable data they were laboriously looked up and properly carded for the index. But if they were short, were published in obscure journals, or were by little known men, they were thrown into "miscellaneous and general," and no further attention was paid to them.

It is really but little short of a crime against science for authors to put at the heads of their articles such faulty and misleading titles. If this is agreed to, then the editors of the journals in which such are published are certainly *participes criminis*. I have talked to a number of scientific men on the subject, but do not recall one who had ever had an editor object to or advise with him as to the wording of his titles. Surely the editors of our scientific journals could and should do all in their power to see to it that the titles of papers which they publish accurately indicate their contents, and thus enable these papers to be quickly and correctly catalogued.

How, then, should a title read so that a bibliographer may correctly classify its contents without having to look the paper up? First, the title should state definitely the subject under consideration—anatomy, embryology, habits, etc. Secondly, it should give both the scientific and the common names of the animal or plant (if it has a common name). The expert in that group of animals will, of course, recognize it by its scientific name, the worker on other animals will place it by its common name. And, thirdly, the group name should if possible be put in. For this the common names, fish, bird, insect, can generally be run in as a matter of course. I recall this title of a fine paper, "On the reactions of [the ghost crab] *Ocypoda arenaria.*" The words in brackets were not there and I was entirely at a loss to know what Ocypoda was. With the bracketed words inserted no one could possibly fail to locate at a glance the animal in its group.

Here follow some sample titles the like of which bring peace and not wrath to the troubled souls of bibliographers and librarians. "On the breeding habits and early development of the ganoid fish, *Lepidosteus osseus.*" "The structure of the skull in the gaff-topsail catfish, *Felichthys felis.*" "The development of the urinogenital system in the bonnet head shark, *Sphyrna tiburo.*" "The migrations of the common mackerel, *Scomber scombrus.*" "The method of locomotion in the climbing perch, *Anabas scandens.*" "The breeding habits of the fighting fish, *Betta pugnax.*"

It may not be as easy to make a good title as a bad one, but it can be done. Papers are written that they may be read; hence it will enhance the reputation of the writer if his titles are so clear that the bibliographer and the researcher must as a glance get the contents. And so, out of a hard and heart-breaking experience, as earnestly as I know how I wish to urge authors and editors to write such clear and definite titles as will make for the quick and accurate cataloguing and hence the ready accessibility of their papers. If so done, then by just so much will science be set forward.

E. W. GUDGER

THE AMERICAN MUSEUM OF NATURAL HISTORY

THE RELATION BETWEEN VOLATILITY AND TOXICITY OF NICOTINE

RECENT studies of nicotine as an insecticide have shown that the toxicity curve of nicotine in solutions is almost an exact parallel of its volatility curve. The efficiency of this widely used insecticide may be so lowered by improper methods of handling that the value of the treatment is greatly impaired, or the lowered rate of toxicity is overcome by increasing the dosage used until the expense is almost prohibitive.

Levorotatory nicotine (free nicotine) is volatile and more toxic than the non-volatile dextrorotatory form (nicotine salts). Reduced efficiency then may result from two reasons: (a) the use of non-volatile nicotine salts, such as nicotine sulfate with insufficient alkali to free the alkaloid from the combining acid; (b) the volatilization or oxidation of nicotine from ground tobacco which is being used as a vermifuge.

The loss of nicotine from concentrated solutions of varying alkalinities was determined by evaporation tests with measured amounts of air at a constant temperature and as a dried film on leaf surfaces. The results from these tests were so uniform that only one will be given, namely, the foliage test. The determination of nicotine was made by the silicotungstic acid method. The solutions were all made with distilled water except as noted. The loss of nicotine in three hours was 51.5 per cent. from nicotine sulfate; 85.9 per cent. from free nicotine, and 89.6 per cent. from nicotine sulfate with sufficient alkali to neutralize the combining acid. Comparing these results with solutions made from tap water as in spray practice, we find a loss of 52.5 per cent. and where soap is added, at the rate of four pounds per hundred gallons, the loss was 63.4 per cent. The maximum volatility of nicotine was attained only by the addition of alkali, while in spray practice it is usually assumed that most waters are sufficiently alkaline, especially if soap is used, to free the nicotine and give the maximum efficiency.

Bioassays of dilute nicotine solutions, but with the same alkalinity as above, were made both by spraying and fumigation. The toxicity to aphids (*Aphis hederae* Kalt and *Rhopalosiphum persicae* Sulzer) ranged from 53.6 per cent. for nicotine sulfate in distilled water (pH 6.5) to 76.5 per cent. for nicotine sulfate solution with alkali to neutralize the combining acid (pH 8.2). Nicotine sulfate in tap water plus soap as above (pH 7.6) had an efficiency of 65.3 per cent.

Fumigation tests with those same solutions on aphids showed a range of efficiency from 48.1 per cent. for nicotine sulfate in distilled water (pH 6.5) to 88.4 per cent. for nicotine freed from the combining acid (pH 7.9).

The same correlation between volatility and toxicity was noted in dust mixtures. Kaolin, powdered vegetable matter and sulfur alone gave a very slow release of nicotine. The addition of 10 per cent. of alkali, such as hydrated lime or sodium carbonate, increased the rate of volatility materially, and correspondingly so the degree of toxicity. Sulfur in large proportions aided materially in increasing the efficiency of the dust mixture. The most effective were those containing 80 per cent. or more of sulfur with about 10 per cent. of alkali. Reducing the amount of

sulfur to 40 or 50 per cent. gave a slower release of nicotine and decreased its efficiency.

E. R. DE ONG

UNIVERSITY OF CALIFORNIA

SCIENCE AND INDUSTRY

IN his speech at the annual dinner of the American Philosophical Society, Professor Lawrence J. Henderson congratulated the society upon the fact that it is not allied and almost in partnership with industry and business, but that it adheres to truth for its own sake and feels no need to advertise its wares and thereby cheapen them.

While no true scientists would ever have other than the *very highest respect* for those who pursue truth *simply* for the sake of truth, they will have *at least equal respect* for those who not only pursue truth for its own sake, but who are also keen to apply the results of their researches for the benefit of mankind, whether it be in the fields of medicine, chemistry, physics or other branches.

On the very page (477) whereon is printed Professor Henderson's address is the conclusion of a paper by Dr. A. S. Hitchcock, who states:

> Finally, I believe strongly that scientists as a class should carry their scientific attitude into the realm of affairs outside the world of science.

JEROME ALEXANDER

THE ARGENTINE WEATHER SERVICE

A FEELING of justice to others leads me to call attention to a mistake by Dr. Harvey W. Wiley in SCIENCE of May 9, 1924, p. 423, where he says of Professor Frank H. Bigelow, "He accepted a call from Argentina to organize the weather service of that country."

The weather service of Argentina was organized by Dr. Benjamin Gould in 1872. In 1876 Mr. Walter G. Davis became director and built the service up from small beginnings to one equaling if not excelling in most ways the meteorological organizations of Europe and North America. He retired in 1915 after 39 years of service and the directorship was assumed by George O. Wiggin.

Under Mr. Wiggin the Argentine Service began forecasting the weather from solar data, using more especially the solar heat measurements of the Smithsonian Institution, and now has a solar observatory of its own fully equipped and manned. It thus becomes one of the leaders of the world in this line.

Bigelow was invited to Argentina by Mr. Davis and his work was scientific research and the application of mathematics to meteorology and not administration.

H. H. CLAYTON

CANTON, MASS.
May 28, 1924.

SCIENTIFIC BOOKS

Chronologia Medica. A Handlist of Persons, Periods and Events in the History of Medicine. By SIR D'ARCY POWER and C. J. S. THOMPSON, New York, Paul B. Hoeber, IV, 278 pages, 84 portraits, $3.50.

THE name of Sir D'Arcy Power, one of the most estimable and worthy of living physicians, is a guarantee for the commendable intention of this book. If we venture to point out sundry slips and blunders in its execution, it is in the hope and belief that "corrective action," in the military sense, will make the second edition what it has every right to be, *viz.*, a reliable as well as useful manual for the student, practitioner and medical librarian. The idea of a chronologic panorama of the progress of medicine is not a new one; indeed, from the eighteenth century onward, medical chronologies of varying merit have been prepared and published at intervals by Sprengel, Choulant, Isensee, Pagel, Aschoff and others. In most of these, the contemporaneous happenings in secular and scientific history are printed, flush with each medical item, across two or more folded pages, necessitating a large format. The present arrangement is tandem, making a compact, handy *vade mecum,* confined to medical items alone. As the writers intimate, a medical chronology is but the skeleton or scaffolding of medical history, whence, in order to "clothe the skeleton" and give a "semblance of vitality" to dry lists of dates, many of the items have been set off by explanatory paragraphs. The authors are of opinion that dates help to fix the outstanding events and personalities of medical history in the mind of the student, at the same time reminding us that, in the earlier periods, such dates can be only approximations at best.

The chronology begins with the Assyro-Babylonian God Ea or Oannes (*circa* 5000 B. C.), who heads a list of medical divinities of Mesopotamia, Egypt, India, Persia, Greece and Rome. The chronology, as such, begins to assume practical shape with Greek medicine on page 13. The first thing noticeable in these earlier pages is that not all the gods and physicians listed are of essential importance, so that this part of the work is a bit cluttered up with those "unfamiliar names" which, in the dictum of Coleridge, "are non-conductors, stopping all interest." The unsophisticated student or the hard-worked doctor, looking for "values" in ancient medicine, will derive small consolation from such shadowy meaningless personalities as Esmun, "son of Synyk," Nenekhsekhmel, Wa T'o and Hua T'o, Syennis the Cypriote, Numenios of Herakleia, "who wrote a poem on fishing," or Uranius, "more famous for his conceit than his medical skill." Toward the later periods, the selection of significant names is almost beyond re-

proach, but such names are invariably allocated, in the chronologic scheme, to dates of birth rather than to dates of achievement, with the fortunate exception of physicians of whom only the period in which they flourished is known. The very purpose of the chronology is defeated when we find Vesalius associated with 1514, the date of his birth, instead of 1543, the date of the *Fabrica,* or McDowell thrown into the eighteenth century (1771), when the whole interest of his life centers around his first ovariotomy (1809). We should not, however, quarrel with his arrangement were it possible to make it consistent throughout, but the orderly sequence of dates is frequently dislocated by such unaccountable entries as 1285 (top of page 62) or 1300 (near end of page 63). But it is in the actual spelling of names, notably inconsistencies in the rendering of names of men of similar nationality, that this attractive handbook stands mostly in need of revision. There is, as Victor Hugo said, a definite *"science des noms"* and the correct spelling of these, whether by poet, historian, bibliographer or chronologist, is coeval in importance with the effective use of significant names in verse or scientific prose. To misspell a well-known name renders the culprit liable to the challenge of Milton's Archangel to Satan: "Not to know *me* argues yourself unknown." In this regard the undersigned was once taken to task rather testily by a physiologist who excelled in another speciality, common to us all, namely, the proper spelling of one's own name.

In the chronology before us, such obvious slips as Ellil (p. 3), plague of Antonius (39), Guilelmo (64), Simon de Corco (64), Brunschweig (68), Mark Antonio (69), Heironymus Mercurialis (95), Merchettis (122), Leeuwenhoeck (126), le Blonde (153), Salvatore de Kenyia for S. De Renzi (202), Fiorravanti (263), and Gitolamo (263) may be mercifully charged up to printer's devil or proofreader. But we have in the same book such inconsistencies as Peter of Abano, Petrus ab Argelata and Pietro Andrea Mattioli, Nicholaus the Salernitan and Nicholas Prepositi (55). If it seems advisable to employ such Italianate forms as Salvino degli Armati or Luigi Rolando for Italians, then why such bizarre combinations as Alexander Benedetti (70), François Valleriola (83), Gabriele Falloppius (93), Constantine Varolio (100), Laurence Bellini (131), John Maria Lancisi (137), Andrew Verga (211) and Philip Pacini (212)? On p. 216, Karl Ludwig becomes Charles William Ludwig and the same carelessness is responsible for "Gasper Bauhine" (104), "Johann [Jean] Riolan" (109), "John Laurance Gasser" (157), "Mara Marat" (169) and "Peter Paul Broca" (222). The work terminates with useful chronologies of drugs and of foundations of universities. The list of drugs (245) culminates in two pyramidal absurdities, *viz.,* "d hyoscyaminé d' camphorsulphonate" and "d' hyoscyine hydrobromide."

It may be noted in passing that George Miller Sternberg was in no sense an epidemiologist, nor was Benjamin Franklin a physician, nor Alexander Kovalevsky a morphologist. On p. 30, it is not clear whether Poseidonius or Zopyrus "wrote on the bubonic or true plague." In a compact handbook, such loose statements as the following surely need reconsideration:

> He based his Methodism upon Epicureanism and so combated mysticism [p. 37].
>
> He was one of the fine flowers of the Eastern Empire when the Roman influence in the West was reverting to barbarism [p. 42].
>
> The teaching was considered to be subversive and led to a prolonged controversy [p. 73].

Excellent as are the portraits, it would be no sin of omission to drop out the caricatures of such great men as Pythagoras (14), Aretaeus (32) and Dioscorides (33), and no admirer of William Harvey can credit the atrabilious presentment on page 109. For practical reference purposes, the bothersome unscientific whim of printing pagination figures at the bottom of the page should be discarded in favor of the ordinary labor-saving practise. Nothing is scientific that leads to waste motion or dissipation of energy.

Apart from these defects, the handsome printing and format are what we have come to expect from the publisher (Hoeber), who will add to his reputation for artistic printing and business enterprise, if he will acquire a competent proofreader.

F. H. GARRISON

MANILA, P. I.

LABORATORY APPARATUS AND METHODS

AN APPARATUS FOR THE STUDY OF MICROORGANISMS IN CULTURE SOLUTIONS UNDER CONSTANT HYDROGEN ION CONCENTRATIONS

STUDIES in the changes produced by microorganisms in the hydrogen ion concentration of their culture medium have been made by a number of investigators in many different ways. The general method which has been followed, so far, consists in growing the microorganisms in some culture medium for different lengths of time and observing the changes produced therein. In the majority of cases, such cultures after being examined once were discarded, because of the danger of contamination; although in a few cases they may have been ex-

amined two or more times. The above method serves only in a relatively limited way, because it does not provide sterile conditions for a frequent determination of the changes produced by the microorganisms in their medium, nor for the introduction of adjusting reagents for the maintenance of a constant hydrogen ion concentration. A somewhat different method was employed by Wolf[1] in the study of the changes produced by bacteria in the hydrogen ion concentration of their culture solution. This consists in introducing some indicator, such as are described by Clark and Lubs,[2] and observing the changes produced in the color of the indicator due to the changes in the reaction caused by the organism. This method is not entirely satisfactory, because of the influence of the indicator on the normal development of the microorganisms and the probable decomposition of the indicator, particularly methyl-red, as a result of their reactions.

The writer,[3] while studying the influence of the hydrogen ion concentration on the growth of Fusaria, devised an apparatus by means of which examinations of the changes produced by microorganisms in their culture solutions and introductions of adjusting reagents can be made at frequent intervals and under relatively sterile conditions. This apparatus provides for the removal of any desired portion of the culture solution for examination and the introduction of any volume of adjusting reagent.

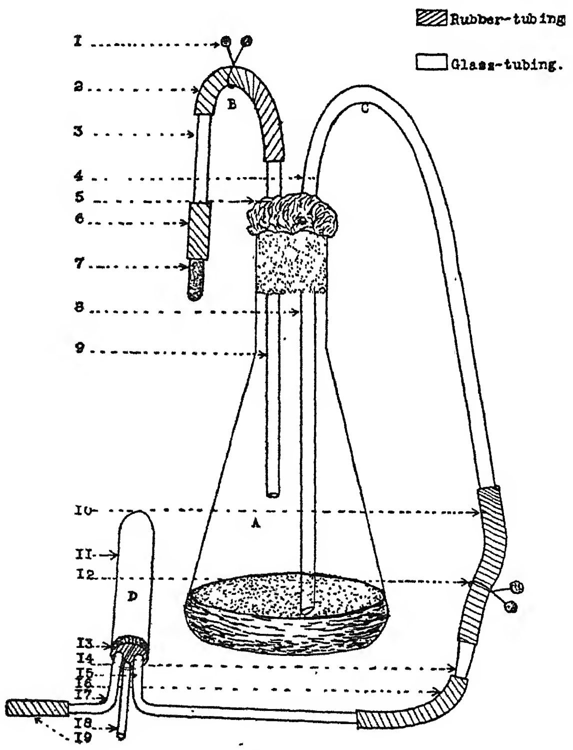

Fig. 1.

[1] Wolf, F. A., "Studies on the physiology of some plant pathogenic bacteria. VII. Pectic fermentation in culture media containing pectin." *Phytopath.*, Vol. 13, No. 9, Sept., 1923.

[2] Clark, W. M., "The determination of hydrogen ions." Baltimore, 1920, pp. 317.

[3] Sideris, C. P., "The influence of the hydrogen ion concentration on the development of the pink root disease of onions" (in press). Thesis for the Ph.D. degree, Univ. of Calif.

The apparatus is very simple in construction and fully illustrated in Fig. I. It consists of an Erlenmeyer's flask (A), carefully plugged with cotton through which are passed two glass-tubes 5 mm in diameter. One of the glass-tubes (B) provides for the introduction of the adjusting reagents and the other (C) for the removal of portions of the culture solution. If desired, two tubes may be provided for the introduction of the adjusting reagents—one for the acids and the other for the alkalies. The other part of the apparatus, which is detachable, is the receiver (D) made out of a test tube (11), plugged with a rubber stopper (13) through which three glass tubes (15), (17) and (18) are passed.

Any desired portion of the solution may be withdrawn from the flask by attaching the one end (16) of the receiver (D) to the nipple (14) of the apparatus and the other end (19) to the suction. Then open pinch cock (12) and close tube (18) by applying the thumb to the opening. When the desired quantity of the solution has been withdrawn tube (C) is raised above the surface of the medium. After all the solution has been drawn into the receiver (D) the pinch cock (12) is closed and the receiver (D) and its attachments are disconnected from the nipple (14).

The adjusting reagents used are placed in flasks which can be made to empty into burettes by means of air pressure generated by a rubber bulb. The opening of the burette through which the discharging glass-tube enters is plugged with cotton in order to prevent contamination from the air. The adjusting reagent to be used must be of such a concentration as to possess disinfectant properties; solutions of 0.2 normal or stronger of either HCl or NaOH may be used with safety. The nipple of the burette in order to be kept sterile is kept immersed constantly in a test tube containing a much stronger solution (about one normal) of the reagent.

Additions of the adjusting reagent may be made to the culture solution by removing the glass rod plug (7) from the rubber tubing (6) and inserting in its place the nipple of the burette which contains the reagent, releasing at the same time the pinch cock (1) to permit the passage of the reagent. The opening of the introduction tube (B) is sealed again

with the glass rod (7), which is dipped in one normal solution of the reagent before insertion.

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A NEW METHOD OF OBTAINING MOSAIC "VIRUS"[1]

IN connection with certain studies on the nature of the causal agent of the mosaic disease it became desirable to secure "virus" with less mixture of foreign substances than could be obtained by filtration of plant extracts through Pasteur or similar filters. It is quite evident that the causal agent of mosaic is carried in the sap of the vascular system of infected plants. By submitting the root system (or the end of a cut stem) to a pressure[2] of about one hundred pounds, it was found that the contents of the vascular bundles could be forced out of the plants and collected with capillary pipettes or medicine droppers. This was accomplished by placing the washed-out roots of the plants in a metal container attached to the city water supply, the stem of the plant extending through a split rubber stopper inserted in a "packing box," similar to that used around valve stems. With a little experience no difficulty was found in making this connection water tight around the plant stem. A succulent mosaic plant with hydathodes readily yields considerable quantities of the liquid water containing the infectious principle, though apparently the "virus" was not as concentrated as when secured from crushed tissue. By cutting the leaf or petioles so as to expose the ends of the bundles the liquid may be secured in a more concentrated form from plants with or without hydathodes. Modifications of the above apparatus and method will be evident to the experimenter to suit the particular needs in hand. It is important to use rapidly growing succulent plants for the best results.

A comparative microscope study of the liquid exuded from healthy and mosaiced plants did not lead to any conclusive results as to the presence of an organism. On slides stained with carbol-fuchsin bodies closely resembling very small bacteria were abundant, but apparently similar bodies occurred in the exudate from healthy plants.

Virus obtained in this way probably closely approximates the virus transmitted by sucking insects, and the method may, therefore, be useful for cross-inoculation studies. This material is also useful in other ways, as, for instance, in attempts at culturing the mosaic agent. The sap as it comes out of the vascular system is usually sterile. It may also prove interesting in studies with other plant diseases, particularly where vascular parasites are concerned.

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[1] Published with the permission of the director of the Wisconsin Agricultural Experiment Station.

[2] This principle was first described by De Bary in studying exudation of liquid water from plants.

SPECIAL ARTICLES

CHROMOSOMAL CHIMERAS IN THE JIMSON WEED

THE production of so-called bud sports is not a rare phenomenon in plants. In general, they may be classified either as sectorial chimeras in which a branch or other portion of the plant shows morphological differences from the rest of the individual, or as periclinal chimeras in which an internal tissue of one type is surrounded by tissue of a different type. The cause of these chimeras has been carefully studied in relatively few cases. Their origin has generally been assumed to be due to somatic mutations in the genes effecting the visible changes. Evidence has been accumulating during the last few years' study of the Jimson Weed (*Datura Stramonium*) that in this species chimeras are brought about by changes in the somatic number of chromosomes, and at least three types of sectorial chromosomal chimeras have been established: (a) those in which one of the sets shows a deficiency of a single chromosome and hence can be represented by the formula $(2n-1)$; (b) those in which the aberrant branch has an extra chromosome, the formula of which would be $(2n+1)$; and (c) those in which one branch has 4n chromosomes or double the number of the normal 2n branch.

(a) *Chimeras with chromosome deficiencies.* In the summer of 1922, two plants from different lines were found each with a branch which showed certain slight deviations from normal. The pollen from both these abnormal branches had considerably more than 50% of abortive grains. Counts of chromosomes in their dividing pollen mother-cells demonstrated a deficiency of one of the largest chromosomes which has been shown to be the extra chromosome present in our $(2n+1)$ mutant known as Rolled. Offspring from these $(2n-1)$ branches failed to show individuals of the parental type, a fact which indicates that gametes deficient for the Rolled chromosome are rarely if ever capable of functioning. In the summer of 1923, a single individual was found with a branch similar in appearance and in the degree of pollen abortion to the two chimeras already mentioned, but the failure of grafts to set prevented a count of its chromosomes. Counts of chromosomes in pollen mother-cells reveal the cytological condition in the subepidermal tissue only and it is possible that these sectorial chimeras were at the same time periclinal chimeras with an epidermal tissue having

a different chromosomal number. That this may have been the case is suggested by the fact that we have found a single plant which was markedly abnormal throughout and distinct from the (2n — 1) branches previously investigated, but which was found also to lack one of the same Rolled chromosomes.

(b) *Chimeras with chromosome excess.* A plant otherwise normal, has been found with one branch bearing leaves and capsules which resembled the (2n + 1) Globe mutant. Chromosome counts have not yet been secured; but offspring from the normal branches were normal, while offspring from the abnormal branch showed the proportion of Globe seedlings expected from Globe parents. The evidence is clear, therefore, that the subepidermal tissue of the abnormal branch of this chimera was (2n + 1) with the extra chromosome in the Globe set. That the epidermal tissue was possibly of a different chromosomal constitution is suggested by the fact that neither the leaves nor capsules on the abnormal branch were fully typical for Globe characters.

(c) *Chimeras with doubled chromosome number.* Several cases have been found chiefly after treatment with cold, in which a single branch on an otherwise normal 2n plant has shown resemblances to a tetraploid. Growth and bud formation in these cases has been poor, but these abnormal branches have been shown to be 4n in generative tissue by the sizes of their pollen grains as well as by the tetraploid offspring which they have produced as contrasted with the 2n offspring produced by the normal branches.

Other and possibly more complicated chimeras which may have a basis in differences in chromosome number are under investigation. The evidence already obtained, however, is sufficient to indicate that chromosomal aberrations may be an important cause in the production of bud sports.

Figures and a more detailed description of the chromosomal chimeras mentioned in the present paper will appear shortly in the *Journal of Heredity.*

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UNIQUE DIETARY NEEDS FOR LACTATION[1]

INVESTIGATION of the dependence of specific bodily functions upon specific nutritive elements is possible because the maintenance of life and, indeed, approximately normal growth are independent of some of those functions. Animals may be reared and will continue to live indefinitely despite disorder, for instance, of the osseous system. It is a matter of practical knowledge centuries old that reproduction may be normal in animals and the function of lactation subnormal or held in abeyance. It has been possible for us to show that active, normal sized and normal appearing rats may be reared by dietary régimes which sterilize them. It has, furthermore, been possible to show that this "dietary" sterility is due to the absence of minute quantities of a specific so-called vitamine substance X, the stability, solubilities and other characteristics of which have now been studied.[2] The commonest dietary régime employed by us in such studies consisted of a well-known mixture of "pure" or isolated foodstuffs (casein 18, cornstarch 54, lard 15, salts 4)[3] together with an abundance of the growth vitamines A and B in the form of butter and yeast. The butter constitutes 9 per cent. of the ration, but the yeast must be fed daily separately in a dose of from 400 to 600 milligrams.

Work with this basal ration of pure food and an abundance of the vitamines at present known should enable us to detect whether or not the function of lactation has other and special dietary dependencies. It is clear that hitherto one could not have amassed the requisite data for such study, since animals do not usually reproduce upon such synthetic mixtures. The detection of the vitamine substance X makes it possible to convey minute but adequate amounts of this substance to animals upon the classic pure food régime and to secure at will reproduction on the régime and to study lactation upon it. Other studies, moreover, have shown that at least one of the foods involved in the pure ration itself, namely, milk fat, possesses seasonally a sufficient contamination with vitamine X to enable animals reared upon this régime to have their first litters. This fact has unfortunately led certain workers to deny the existence of a vitamine which determines reproduction. We have designated this phenomenon "first litter fertility," for upon the same régime the same animals are subsequently sterile. It is due, we believe, to a low amount of dietary vitamine X augmented by

[1] Aided by grants from the National Research Council (Committee for Research on Problems of Sex) and the United States Department of Agriculture (Dairy Division).

[2] Evans and Bishop, SCIENCE, Vol. 56, p. 650, Dec. 8, 1922; *Jour. of Metabolic Research,* Vol. 3, No. 2, Feb., 1923; and Evans and Bishop and Evans and Burr, Proc. Amer. Assoc. Anat., *Anatomical Record,* Vol. 27, No. 4, April, 1924.

[3] Salts. The salt mixture employed was identical with that used by E. V. McCollum and consisted of

NaCl	0.173
$MgSO_4$ (anhyd)	0.266
$NaH_2PO_4 + H_2O$	0.347
$CaH_4(PO_4)_2 + H_2O$	0.540
Fe citrate	0.118
Ca lactate	1.300
K_2 HPO_4	0.954

low but constant amounts of X already in the tissues of young animals, since we have proved that the substance is transmitted to them in intrauterine life.

These cases of first litter fertility in animals upon the basal "pure" diet have proved of great value to us in our studies upon lactation. Furthermore, in the cure of sterile animals by the administration of alcoholic or ether extracts of a food substance high in X—wheat germ—it has been possible to study the lactation of animals with induced fertility upon the "pure" régime, modified by the insignificant addition involved in a minute amount (one to six drops) of wheat germ oil daily. About 100 young have been weaned from mothers showing first litter fertility on the basal régime and over 300 have been suckled by mothers likewise on the basal ration but whose fertility was provoked by minute doses of the lipoids found in the embryo of wheat. A singular correspondence obtains in the results secured with both of these large groups. *Lactation is always seriously impaired upon the "pure" diets.* The average weaning weight of the animals resulting from such lactations is almost exactly half that which is normal, *i.e.,* 20 grams instead of 40 grams on the twenty-first day of life. Distribution graphs of the actual weaning weights in the two groups show no overlap (Figures 1 and 2). In practically none of the pure food young is a normal weaning weight secured. Furthermore, the mothers lose approximately five per cent. of their body weight in the performance. *It hence seems to us established that the function of lactation demands for its normal expression either one or more dietary elements different from those adequate for normal growth and for normal reproduction, or else larger quantities of certain dietary elements.*

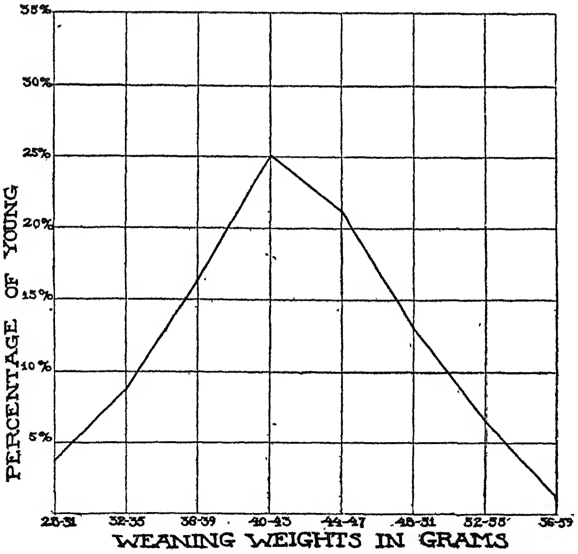

FIG. 1. Distribution of weaning weights (twenty-first day of life) of 503 rats, the mothers of which were on Standard Diet 1 (whole wheat 67, whole milk powder 10, casein 15, NaCl 1, $CaCO_3$ 1.5, milk fat 5).

Striking as are such results, it is conceivable that they are due to the impairment of the young. It may be stated that the new-born of rats on natural foodstuffs are slightly heavier (one gram) and apparently more vigorous than are the pure food nurslings. Some slight abnormality of the young born from "pure food" gestations might be the cause of their inability to grow well during the lactation period. But they grow normally afterwards and a conclusive answer to this contention is furnished, we believe, by a group of exchange experiments which we have instituted. As many as a hundred young from cases of sporadic fertility have now been interchanged with a hundred young from normal mothers upon a generous table scrap diet. The experiment was done in such a way that the normal mother was

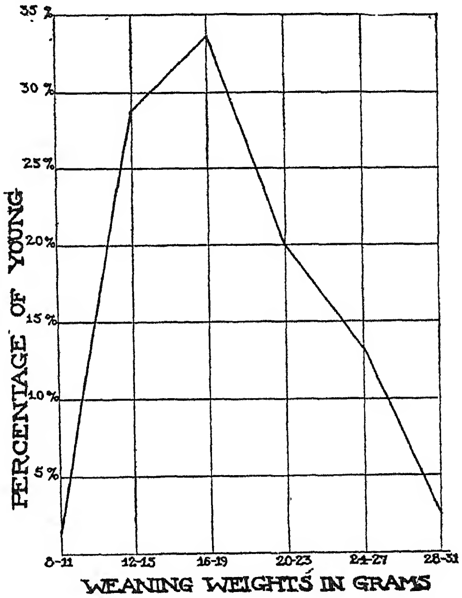

FIG. 2. Distribution of weaning weights of 134 young of mothers on Basal "Pure Food" Diet (casein 18, cornstarch 54, lard 15, milk fat 9, salts 4, yeast daily .5 gram).

forced to accommodate equal numbers of her own and of the synthetic food young, and, conversely, the synthetic food mothers were required to suckle normal young as well as their own. In all cases the litter size was reduced to six. The experiment has shown us that *the young from pure food mothers when suckled by normal mothers possess the same capacity to grow during lactation as do normal animals suckled by their own mothers,* for during the three weeks' lactation period they increase their body weight about seven times. With their

own mothers this increase would have been, roughly, four times. Conversely, normal young suckled by pure food mothers increase their body weight but four times in spite of the somewhat superior vigor with which these animals start life.

Now it is conceivable that the excellent lactatory powers of the normal animals are not actually due to the food consumed by them during the lactation period, but to "reserve" substances in their tissues which can be called upon in this unique need. An answer to this is given by the imperfect lactation resulting when an animal is shifted from a satisfactory diet to the "pure" one. The mammary stimulant must hence be an element of the food.

The natural foods therefore contain a substance, or substances, essential for the normal function of the mammary gland. We have been able to shed some light upon which particular natural foods contain and which do not contain this material, which may be variously termed the lactation auximone, or auximones, or nutritive galactagogue according to one's preference. Early in our studies various amounts of different natural foods were added to the basal pure diet in order to induce fertility, and we took occasion to study not only the function of reproduction but, when young were born, that also of lactation. Many substances (*e.g.*, vegetable oils) which induce reproduction do not improve the lactation of animals upon the basal régime; on the other hand, some of them greatly improve mammary function. Among the substances studied are leaves, grains and animal tissues. A considerable body of data has been secured with the use of lettuce, wheat, egg yolk and beef muscle. Fresh leaves in high amounts improve lactation; when dried, they do not do so. Wheat embryo does so when fed as a considerable portion of the ration. Egg yolk and meat help lactation markedly. Furthermore, the fat has been extracted from both egg yolk and wheat embryo, and in their fat-free form these foods were as effective in galactagogic action as they were formerly. It would appear, therefore, that the food material necessary for normal mammary function is not soluble in fats. Implication of a protein factor is suggested by the potency of meat and grains, even though experiments with milk itself make it seem less likely that either protein or inorganic matter constitutes the dietary substance conditioning normal mammary performance. The total milk solids (we have used as much as a third by weight of the entire ration in the form of whole milk powder) do not repair lactation delinquency so effectually as do the other substances mentioned. Yet the difference between bovine and muridine milk in these very constituents robs such an argument of crucial value. Attention is being paid to the distribution and possible isolation of the food constituent in question. It is by no means ascertained that this is not a well-known substance. A suggestion, however, that this is not the case and that we may be dealing here with one of those specific stimulants to the biochemical mechanism constituted by the so-called auximones like *bios*, is furnished by the superior effect of fresh leaves when contrasted with the same desiccated leaf substance. Be that as it may, a single conclusion—yet an important one—seems clearly validated by the "pure food" lactation studies. Food requirements for normal lactation in the rat are not fulfilled by the classical "synthetic" dietaries of fat, carbohydrate and protein, together with salts and an abundance of the known vitamines A, B, C, D and X—dietaries entirely adequate for growth and reproduction.

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DIVISION OF ORGANIC CHEMISTRY

(Continued)

3-amino-4-hydroxyphenylarsine: G. W. RAIZISS and B. C. FISHER. This dihydrochloride of 3, 3′-diamino-4, 4′-dihydroxyarsenobenzene, known under the names of arsphenamine and salvarsan, is a remedy of great value in medicine. Its oxidation product, the 3-amino-4-hydroxyphenylarsineoxide, possesses a still greater destructive effect upon parasites, but it is more toxic and therefore has not been used in treatment of diseases. The authors were interested to study the biological properties of the reduction product of the first-named compound and therefore it became necessary to secure the product as pure as possible. German and English patents in which the preparation of the 3-amino-4-hydroxyphenylarsine is described, when followed, gave extremely small yields and a very impure product. A systematic and prolonged study led to a satisfactory method which gave comparatively good yields and what is very important, a chemically pure product. This arsine was made from arsphenamine by the reduction with zinc dust and hydrochloric acid at 40° C. It was precipitated out by means of a saturated solution of sodium acetate. The crude product was extracted with ether, the work having been performed strictly under pure nitrogen gas. The crude product has been purified four times, dissolving it in dilute alkali and reprecipitating by acetic acid. This again was done under nitrogen. The product so obtained represents a pure white substance easily oxidizable to the yellow arsenobenzene. It is an interesting substance from the biological standpoint, being highly trypanocidal, more so than arsphenamine and the corresponding arsineoxide.

The use of silicon tetrachloride for the synthesis of acid chlorides. (By title): R. E. MONTONNA and H.

HIBBERT. Silicon tetrachloride can be used for the manufacture of acid chlorides from the corresponding acid. In general, one mole of acid was used to one mole of silicon tetrachloride, temperature and operating conditions varying with the acid employed. In most cases it is advisable to dilute the acid with an inert solvent, for example, toluene, xylene, etc. The yields of acetyl-, propionyl-, butyryl-, iso-butyryl-, benzoyl and phenyl acetyl chloride were 85 per cent., 50 per cent., 49 per cent., 53 per cent., 77 per cent., 61 per cent., respectively. It is best to use an iron reaction vessel with suitable agitator, when the residue left consists only of dry silica in a form of powder.

Thermolysis of organic esters: H. HIBBERT and E. M. BILGER. Both organic and inorganic esters decompose on heating, and their behavior is similar in many respects. With organic esters the nature of the decomposition into acid and hydrocarbon varies with the type of ester employed. Ethyl acetate and other esters containing hydrogen atoms attached to the carbon atom in the beta position to the ether oxygen, when heated above a definite temperature limit decompose smoothly into acid and hydrocarbon. Those esters containing no hydrogen atoms in this position are much more stable (methyl acetate, benzyl benzoate, etc.). The mechanism of the reaction may consist of either a straight dissociation (Neff) or intermediate formation of a five-, four- or three-membered ring, and the authors submit certain theoretical speculations as to the mechanism involved in such decompositions.

The application of the diazo reaction in the synthesis of diaryl compounds: M. GOMBERG and W. E. BACHMANN. About 20 compounds of this nature are described, which have been prepared in this manner and the constitution of which has been definitely determined.

New researches on the proteins of silk: E. M. SHELTON and T. B. JOHNSON. The research in progress is a continuation of an investigation of silk proteins which has been in operation for several years. New evidence has been presented through X-ray analysis by other workers that fibroin of silk is a mixture of two or more proteins. Conclusions regarding the uniformity of the protein sericine has never been established and the chemistry of this substance is at present in a very undeveloped state. This research has dealt with a critical study of the properties and chemical behavior of sericine prepared under different conditions. The action of the enzyme pepsin has also been incorporated in the research. Data have been obtained which have revealed a clearer understanding of the behavior and the practical utility of this enzyme as a degumming agent.

Dissociation and reversible rearrangement of the propyl bromides by heat, and their formation from propene and hydrogen bromide: R. F. BRUNEL and H. G. RAFSKY. Heating of either normal or isopropyl bromide in the gas state gives an equilibrium mixture of the two bromides with their dissociation products, hydropropyl bromide and propene. The ratio of iso- to normal propyl bromide at 300° is 73:27. The degree of dissociation of these bromides does not differ greatly from that of the butyl bromides previously investigated. The action of hydrogen bromide on propene gives mixtures running all the way from nearly pure n-propyl to nearly pure isopropyl bromide.

Evidence of the symmetrical constitution of the dihalogen substitution products of acetylene: L. B. HOWELL. In studying the reactions of C_2Cl_2, striking evidence against the existence of so-called acetylidine structure, *i.e.*, $Cl_2C:C$: (Nef, Ann., 298, 345, 361; 308, 325) is found. When dichloro-acetylene adds a mole of iodine it should, according to Nef's theory, give $Cl_2C:CI_2$ identical with the chlorination product of C_2I_2. Iodination of C_2Cl_2 has been carried out, and it is found to yield a $C_2Cl_2I_2$ (w. solid, m.p. 67.5°–8.5°) different from the liquid isomer (m.p. 2.5°–3°, b.p. 243°) obtained from C_2I_2 and chlorine in previous work. These dichloro-diiodo-ethylenes are evidently the cis and trans stereomers. $ClIC=CClI$. Similar evidence is found in the fact that C_2Cl_2 upon bromination gives the symmetrical $ClBrC:CBrCl$ (b.p. 172°) obtained by Swarts from $CClBr_2 \cdot CHClBr$ and alcoholic KOH. (Cent., 1889, 1, 588.)

The behavior of acetylene and cuprous chloride catalyst in an ammonia system (By title): H. WENZKE and J. A. NIEUWLAND. Acetylene condenses with aniline in the presence of cuprous chloride catalyst to form a substance thought to be bis-ethylidine aniline. When this is heated, a rearrangement takes place with the formation of substituted quinolines. The reaction takes place with the formation of substituted quinolines. The reaction proceeds much like a Skraup's synthesis, especially when nitrobenzene is added in the presence of HCl solution. Efforts to prepare, or rather separate a pure compound from quinaldines have not as yet been successful, except the identification of β-methyl-quinoline. The mixture has a boiling point range from 200° C. to over 300° C., and it is impossible to make any separations with fractional distillation. Mono-ethyl-analine reacts similarly to aniline, except that the product is less fluid in nature. In the condensation with CuCl as a catalyst, the optimum concentration of the catalyst was 6 per cent. to 7 per cent. of the weight of the reacting mixture. Benzylamine, dimethylaniline and diphenylamine were also tried.

The reaction of bromo-nitro-methane with aromatic compounds in the presence of aluminium chloride: M. L. SHERRILL. An investigation of the reaction of bromo-nitro-methane upon the following aromatic compounds has been made: benzene, mono-bromo-benzene, mono-chloro-benzene and anisol. In every case that has been studied, the isolation of two types of products indicates the main trend of the reaction. The one type is either the aromatic nitro-methane, or the corresponding aromatic aldehyde or acid, the latter two compounds formed by the decomposition of the aromatic nitro-methane; the other type is the brominated aromatic compound. The yields of the former type of product have been from 10 to 45

per cent. of the theoretical, while those of the brominated compounds have been from 25 to 65 per cent.

The preparation of thioacetic acid: H. T. CLARKE and W. W. HARTMAN. Hydrogen sulfide does not react with either acetic anhydride or acetyl chloride alone, but readily converts acetic anhydride into a mixture of acetic acid and thioacetic acid in the presence of a small proportion of acetyl chloride. Hydrogen chloride, sulfuric acid and acetyl bromide act in the same way, the last being a particularly efficient catalyst. The resulting thioacetic acid and acetic acid may readily be separated by fractional distillation.

Hydroxamic acids of hydroxy and alkoxy fatty acids: D. H. POWERS and L. JONES. Glycolic ethyl ester reacts with hydroxylamine in alcohol solution to give glycolhydroxamic acid, m. p. 85°, from which were prepared the benzoyl and acetyl derivatives and their salts. The rearrangement of these salts in alcohol solution does not give the expected urethanes, but allophanic ester: a product which may be explained by the formation of cyanic acid in the course of the rearrangement. Methoxyacethydroxamic acid and ethoxyacethydroxamic acid were prepared from the ester and acid chloride, and their derivatives prepared and studied. Rearrangement of their salts does not give the amines of urea derivatives expected, but their decomposition products: carbon dioxide, ammonia, formaldehyde and methyl or ethyl alcohol. Attempts to prepare these amines by other methods invariably gave the same decomposition products. Methoxymethyl isocyanate, b. p. 87°, and ethoxymethyl isocyanate, b. p. 106°, were prepared from silver cyanate and the corresponding monochlor ethers. In the presence of moisture, they were hydrolyzed to carbon dioxide, ammonia, formaldehyde and methyl and ethyl alcohol, respectively.

Action of the hypochlorous acid on alcohols: M. C. TAYLOR, R. B. MACMULLIN and C. A. GAMMAL. It has been shown that the action of HOCl on monohydric alcohols to form esters is a general reaction. Determinations of molecular weight of ethyl hypochlorite based on alcohol and chlorine content and on vapor density agree in showing that this compound is an ester and not a double compound similar to those described by Kendall. Comparatively stable solvent solutions of these esters may be readily prepared by shaking HOCl, made by chlorinating a limestone suspension, with alcohol and a solvent immiscible with water. The reaction proceeds to equilibrium so rapidly and uniformly that the distribution of the available chlorine between the water and solvent layer can be used as a means of estimating accurately the amount of alcohol present. A physical chemical study of the action of HOCl on ethyl alcohol in the presence of CCl_4 has been made including the following points: (a) Equilibrium constant of the reaction HOCl — EtOh — EtOCl — H_2O. (b) Distribution ratio of EtOCl between CCl_4 and water. (c) Effect of temperature on rate of reaction. It has been found that these solvent solutions can be made to react with hydrated lime and water to form solid calcium hypochlorite which can be filtered off.

Hyponitrites: A. W. SCOTT and L. W. JONES. Sodium hyponitrite was prepared by the action of ethyl nitrite on free hydroxylamine. Since the alkali hyponitrites are most stable in an alkaline solution, methanol containing sodium methylate was employed as the reaction medium. Sodium hyponitrite was obtained in a yield of 13½ per cent. and in a state of comparative purity. Silver hyponitrite was made by the addition of an aqueous solution of silver nitrite to a neutral aqueous solution of sodium hyponitrite. The yield was practically quantitative.

A contribution to the chemistry of pyruvic ureide: D. DAVIDSON and T. B. JOHNSON. The name pyruvic ureide indicates a product of reaction formed by condensation of pyruvic acid with urea. It is represented structurally in chemical literature as a monomolecular compound containing free methylene group as illustrated by formula I. Gabriel has assigned the constitutional formula II to this compound. New evidence has been obtained indicating that the formula given by Gabriel is correct.

$$\mathrm{NH \cdot CO \cdot NHCO \cdot C : CH_2}$$

I

$$\mathrm{NHCONHCOC : CH \cdot C(CH_3) \cdot CO \cdot NH \cdot CONH}$$

II

The research has also involved the study of the nitro derivatives of pyruvic ureide III, particularly its behavior on reduction. It has been found that this substance behaves in a manner analogous to nitrostyrene and is reduced in the presence of platinum to the oxime of hydantoin aldehyde IV.

$$\mathrm{NH \cdot CO \cdot NH \cdot CO \cdot C : CHNO_2} \quad \text{to}$$

III

$$\mathrm{NHCONHCO \cdot CH \cdot CH : NOH}$$

IV

Preparation and hydrolysis of di-n-butylcyanamide and diallylcyanamide: E. B. VLIET. A method was desired by which di-n-butylamine and diallylamine could be prepared in relatively pure form, free from primary and tertiary amines. The hydrolysis of the corresponding cyanamides, using dilute sulfuric acid, furnished a very satisfactory method.

$$\mathrm{R_2NCN + 2H_2O = R_2NH + NH_3 + CO_2.}$$

Di-n-butylcyanamide and diallylcyanamide were prepared by first obtaining a solution of sodium cyanamide by the action of sodium hydroxide on a suspension of lime nitrogen in water. This, upon addition of alcohol, readily reacts with butyl and allyl bromides to form the desired products.

J. A. NIEUWLAND,
Secretary

(*To be continued*)

SCIENCE

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BACON'S COLLEGE OF RESEARCH[1]

IT is a common trick of the human mind to estimate the progress of science in a sort of backward survey, reversing the perspective glass of history by turning its eye-piece away from the observer. We unconsciously project into the record the connotations of a later experience and thus distort its true values. The process is as prejudicial to our judgment as it is flattering to our vanity. This is what Sir Henry Wotton means when he says, "we are extremely mistaken in the computation of antiquity by searching it backwards."

Nowhere is the computation of antiquity backwards more fatal to a clear understanding of the past than in dealing with language. We think of Shakspere, for example, not as employing the English of the early 17th century, the only English that he could possibly know, and doing it with a fullness and accuracy that has never been surpassed by any of the great masters of human speech; we think of him as patiently endeavoring to clothe his resistant genius in the connotations of twentieth-century English, and hitting them not quite happily.

So it is with Bacon. We think of him as attempting to formulate science in the terms of our modern concepts, and project into his words scientific connotations that were not born until a century later.

Let us, then, on this three-hundredth anniversary of the publication of a book which revolutionized scientific method and set in motion a "new Philosophy," whose infant society of a handful of enthusiasts was to be the parent of great scientific organizations like the British and American Associations for the Advancement of Science—let us, then, take 1623 as a bench-mark for our theodolite and make a forward survey of the "proficience and advancement" that learning has achieved during the last three centuries.

Putting ourselves in Bacon's position at the beginning of the seventeenth century and surveying the then state of learning through his eyes, we find an intellectual system that is based upon Plato and Aristotle. These great thinkers, master and pupil, had assumed as the foundation of knowledge certain self-existent and predetermined principles—Plato calls them "ideas," Aristotle, "forms"—which it was the business of nature to illustrate and of man to realize. Plato had concerned himself chiefly with the manward relations of his "ideas," and organized them into

1 A paper read before Section L of the American Association for the Advancement of Science on the 300th anniversary of the publication of Bacon's *de Dignitate et Augmentis Scientiarum*, December 31, 1923.

a system of philosophy: Aristotle had chiefly devoted himself to an organization of the nature-ward aspects of his "forms," and organized them into a system of science.

It was this philosophy and this science, with all the subsequent elaborations of the Middle Ages, that Bacon found intrenched in the universities. The former, however, dealing with causes, was then called "science."[2] The latter, dealing with effects, was called "philosophy," and Aristotle, from the 14th to the 17th century, was styled "the philosopher" *par excellence*. Curiously enough, in the last three centuries the two words have just reversed their connotations.

In the Aristotelian science the *organum*, or tool of knowledge, was the syllogism; and to impugn the efficacy of the syllogism as the instrument of ultimate knowledge was in the 17th century to fly in the face of God himself. That Bacon should dare to do it while yet an undergraduate at Cambridge is evidence of the splendid audacity which always characterized his thinking. To project a new point of view when the world is prejudiced against it and "with loud clamor hooteth the projector, this is not an undertaking for dullness or cowardice." And Bacon's mind, "beating out its own way in untravelled places," never lacked the courage of its convictions.

His first step on the new path, taken in his young Socratic faith that all men would follow the truth once they caught a glimmer of its light, he enthusiastically termed *Temporis Partus Maximus, i.e.*, "The Greatest Thing that Ever Happened." Fancy the effect of a title like that on the staid sensibilities of an Oxford or Cambridge don as he confronted it for the first time staring at him from the shelves of a university bookstall. No wonder Bacon never achieved an academic degree! Even his later admirers were shocked at the audacity of this title. Archbishop Tenison, in "An Account of all Lord Bacon's Works" (1679, p. 9), has this to say of the *Partus* (later absorbed in the *Instauratio*): "That book (pompous in its title but solid in its matter, like a great feather put sometimes on a good headpiece) contained in it, though in imperfect manner and so far as the greenness of his years permitted, the principal rudiments of his Instauration—a work so vast and complete that—it seemeth true that he framed the whole model of the House of Wisdom." (Note this phrase, "the House of Wisdom," the *Aedes Salomonis:* it is Bacon's name for his college of research, which we shall concern ourselves with shortly.)

In like manner all Bacon's titles were calculated to insult the complaisant mediocrity of the academic powers that then were—as he himself puts it, they "fly high over men's heads." His works are always sounding the triumphant note of discovery—the *Novum Organum Scientiarum* ("The New Instrument of Knowledge"), the *Parasceve* ("The Passover Preparation"), the *New Atlantis* ("The Lost Continent Found Again"). And they are written *in verbis masculis*—no "flourishing or painted words, but words such as are fit to go before deeds."

He later lost his faith in the open-mindedness of humanity, but he never lost the conviction that he was on the right path, and never faltered in the courage necessary to pursue it. The goal toward which he consistently pressed all his life long was a new world enriched by the fruit of an organized scientific research systematically proceeding, discovery by discovery, to the ultimate fullness of truth.

Ever practical, with this end in view he undertook a complete survey of the state of human knowledge in 1605. The result of his labors he dedicates to his scholar-king, James I, under the English title "The Proficience and Advancement of Learning." With our habit of "computing antiquity backwards" we quite miss the significance of this title. For in the 17th century "proficience" may mean "worth," "practical value." That this was the meaning Bacon had in mind is obvious from his corresponding Latin title, *de Dignitate*. His purpose in writing the book was thus practical; not academic—*to demonstrate the value of science in the service of humanity and point out the means by which this value might be progressively enhanced.* His survey covers the whole field of human knowledge at the beginning of the 17th century.

He finds most of the contemporary sciences dry and barren—*deficiens*.

It may be of interest to note in passing that he has no fault to find with the science of language. The two divisions of this *rational knowledge* (which is his term for what we think of as "applied science") are grammar and literature, with poetry as the highest form of the latter. Bacon's conception of language was the then prevailing, and not yet quite extinct, view of Aquinas. God gave it to Adam in the Garden of Eden as a means of naming things. Man perfected it until the awful disaster of Babel. Bacon naïvely maintains that man has partially recovered from the effects of his "second curse," as it was known among the schoolmen, by adopting the comparatively perfect language of the Latins as a means of universal communication.

A scientific conception of language was not to dawn on the world until the end of the 18th century through the patient labors of such scholars as Hickes and Junius; its fundamental laws were not to reach a definite formulation until 1822 with Jacob Grimm's discovery of the Germanic Sound Shift; its "proficiency" as a science was not to be formally recognized until the present Year of Grace, 1923.

[2] Milton's Eve, when she first discerns the knowledge of good and evil on eating the forbidden fruit, apostrophizes the apple as the "mother of science" (P. L. IX, 980).

Proceeding in his relentless logic Bacon inquires into the cause of the deficiency he has pointed out. He finds it in the universities with their inevitable tendency to sacrifice the original mind to the exigencies of the academic system.

The second book of the "Proficience and Advancement" is worthy our careful attention as clearly demonstrating Bacon's conception of the proper place of research in university education. He finds (p. 95) that the great universities are "dedicated to professions, and none left free to arts and sciences at large." This frantic pursuit of professorial and professional learning, he says, is the folly described in the ancient fable of the idle stomach and the active members. "If any man thinks pure science to be an idle pursuit he fails to realize that from thence is all applied science supplied." He maintains that this neglect of pure science in the universities is the "great obstacle that stands in the way of the advancement of science," because, in consequence of it, "fundamental knowledges are studied but in passage"—*i.e.*, the sciences that are fundamental to progress are studied only superficially. "If you will have a tree bear more fruit than it hath used to do, it is not anything you can do to the boughs, but it is the tilling of the earth and the supplying of fresh energies to the roots that must worke it."[3]

The pursuit of these professional ends, Bacon goes on to say, produces college professors who are quite unfit for intellectual leadership; they are not "able" (*virile* in modern English) and "sufficient" (our modern *efficient*) men, but the kind that easily submit to authority and tradition. The professorial class, he maintains, should be selected and set apart with a view to breeding the intellects of the coming generation. They should therefore be men who are conspicuous for intellectual virility and vigor. But their present mode of selection defeats this purpose. For the "smallness and meanness" of its rewards and emoluments as compared with those attainable by the practice of other professions is such that an academic career holds out no attractions to induce virile men to devote their entire energies and whole lifetime to it; and the consequent imbecility propagates itself into succeeding generations, so that the devitalized children reflect the starved features of their fathers—

Et Patrum invalidi referent jejunia nati.

Another deficiency Bacon points out in the universities of his day is their reliance upon text-books, and their failure to provide adequate facilities for research in the way of laboratories, botanical gardens and other instrumentalities of investigation (p. 97). Those in authority refuse to authorize the bills of expense, necessarily large, which the provision of such tools renders necessary. With that peculiar aptness of pointed analogy which characterizes his thinking, Bacon maintains that research is the intelligence department of organized knowledge, and that scientific investigators are the "espialls and intelligencers" of nature. When a government cuts down the bills of its intelligence department it puts out its own eyes, and as a consequence is ill advertised of the plans and movements of its enemies.

As to text-books, the situation is to be met not by ceasing to produce books, but "by making more good books."

Another weakness in the contemporary institutions of higher learning, he maintains, is the admission of students immature and untrained in the processes of scientific thinking (p. 99); in catering to the capacity of these immature students, knowledge "is made almost contemptible, and has degenerated into childish sophistry and ridiculous affectation"; and the precocious pupils develop the superficiality characteristic of the capacity of children.

Bacon stigmatizes still another deficiency in the universities of his time in their lack of mutual understanding and sympathetic aims and ideals—"intelligence mutual, contract and fraternity"—and their waste of energy and duplication of effort consequent upon a lack of cooperation and coordination—"conjunction of labors."

On page 215 he reaches his final conclusion that there is no health in these institutions because they forestall research; they have abandoned this road and walled it up—it has become a *via deserta et interclusa*. With a lawyer's shrewdness he points out the fact that the fundamental contract of these university societies is one by which the parties agree to hoodwink each other.

'As knowledge is now delivered there is a kind of contract of error between the deliverer and the receiver. The one desires to present his knowledge in such a way that it will fit in with established opinions, and not in such a way that it may be tested by actual experience; the other desires immediate satisfaction rather than stimulus to further enquiry—to believe without qualification rather than to ascertain the truth through his own efforts. Thus regard for his reputation makes the Master conceal his ignorance, and mental inertia keeps the disciple from liberating his own intellectual energies.' (Adv., p. 215.)

Bacon's magnificent program for establishing research as the means of regenerating learning in the service of humanity followed two lines: one to provide the scientific method for the *magna instauratio;*

[3] Pasteur's later words, "There exists no category of the sciences to which the name applied science could rightly be given; we have science and the application of science, *which are united together as the tree and its fruit,*" sound like an echo of Bacon's.

the other to provide the material and personnel to make it effective.

The former task proved greater than he had anticipated, but was at last accomplished in his 59th year with the publication of the *Novum Organum* in 1620. In 1623 he incorporated the new system in an enlarged and extended Latin version of the proficience and advancement, under the title *de Dignitate et Augmentis Scientiarum,* bringing the New Philosophy to a point.

We are apt to take this book out of its context and compute its significance backwards. But when we look at it with the eyes of Bacon's contemporaries we can easily realize how an arraignment of the intellectual life of the time as shrewd and relentless as this was should raise for its author such a host of implacable enemies that he would have little opportunity to carry out the second part of his program. And that was what happened. Six years later their animosity culminated in the tragic triumph which broke Bacon's heart and sent him down to posterity a dishonored name.

But in spite of the fact that Bacon is only known by his system of induction, which, by the way, is fundamentally different from the Aristotelian ἐπαγωγή in that it has discovery and not demonstration for its end, and definitely provides for working hypotheses which may either run counter to ἐπιστήμη or for a time prove mutually irreconcilable—in spite of this fact, there appear here and there throughout the records of his life evidences that he had always in mind the practical side of his problem, and contemplated the establishment of a great college of research independent of the universities, as the goal of his endeavor. It was probably this end, requiring enormous financial resources for its achievement, that made him so avid of money that posterity has stigmatized him as avaricious.

We fortunately have Bacon's own memoranda of his plan of organization for this new college (Spedding IV, pp. 25, 26). These rough notes were made in July, 1608. The real purpose and intent of the proposed foundation are involved in a phrasing whose significance we quite miss because its Elizabethan words have changed their meanings since Bacon's time. "Invention," for instance, in the 16th century means "research," or "discovery," and an "inventor" is a discoverer of new knowledge (see New English Dictionary, 1); the restricted modern sense of "inventor" is expressed in Elizabethan English by "engineer." The draft for the College of Research that was to build the New Philosophy into a scientific working organization runs as follows:

The foundation of a College for Inventors. . . . Galeries with statuas for Inventors past and spaces or bases for Inventors to come. And a Library and Inginary.

The Order and Discipline to be mixt with some poynts popular to invite many to contribute and joine.

The rules and prescripts of their studyes and inquyries.

Allowance for travailing; allowance for experiments; Intelligence and Correspondence with Universities abroad.

The manner and Prescripts touching Secrecy, Tradition, and Publication.

Removes and Expulsions in case within a tyme some Invention worthy be not produced and likewise the honors and rewards for Inventors.

Vaults, furnaces, Tarraces for insulation, woork houses of all sorts.

Translated into modern English this gives us the following scheme:

(a) The foundation of a college of research with (1) a hall of fame for statues of those who have contributed to the advancement of science in the past, and (2) bases for statues of those to come, together with (3) adequate library and laboratory facilities.

(b) The plan of organization must contain attractive features to induce public-spirited benefactors to contribute to the support of the college, and scientific men to join its fraternity.

(c) Rules and regulations for the conduct of studies and investigations.

(d) Allowances for travelling expenses; allowances for experiments; allowances for correspondence and communication with foreign universities.

(e) Methods of and regulations for recording such conclusions as are to be kept in cipher until the time is ripe for their publication; for imparting instruction to new-comers; and for the publication of such discoveries as are to be given to the world.

(f) Regulations for removing members who produce no valuable discoveries, and for honoring and rewarding those who do.

(g) Vaults, furnaces, platforms for exposing things to the action of the sun, work-shops of all kinds.

The outstanding feature of this project for a college of research is its startlingly practical character. With the exception of its fifth provision of secrecy and restricted publication,[4] which the subsequent progress

[4] It was an endeavor to determine the scientific significance of his Bi-Literal cipher to which Bacon gives so much space in the *de Augmentis,* that led the writer of this paper first to organize the material here presented—and he is especially indebted to Colonel George Fabyan for free access to the magnificent library of Bacon's work and Baconiana assembled at Riverbank. This library, besides containing one of the very rare copies of Bacon's "de Augmentis," 1623, is unusually rich in materials relating to cryptography and Rosicrucianism. Out of the latter movement developed the earliest ascription of Shakspere's Works to Francis Bacon. Bacon divides research into *Inventio* (*i.e.,* discovery), *Memoria* (*i.e.,* record) and *Traditio* (*i.e.,* handing down to posterity). His *Traditio* is to be selective; for he clearly realizes that the New Philosophy will yield new principles of science which

of science has rendered supererogatory, Bacon's program might well be adopted *in toto* by modern foundations for research.

Its controlling idea is service—"proficience"—and its end the "advancement" of science through successive discoveries; moreover it mechanically excludes from "research" all those multifarious varieties of compilatory investigation (what Zupitza used to call *reine belesenheit*) which so clog our modern research endowments.

That Bacon's project was no mere passing display of intellectual acumen—in his own words, a "matter of strangeness without worthyness"—is at once evident when we turn to the *Atlantis* and read this fragment in the light of the provisions outlined above.

Scattered through Bacon's writings here and there are references to the "House of Wisdom," or its Latin equivalent *Aedes Salomonis.* This was his name for his projected college. We have seen Archbishop Tenison definitely employing it with this significance. That it was familiar to the two generations following Bacon is evident in the writings of the 17th century century Rosicrucians, whose organization was an offshoot of the New Philosophy and made the *Atlantis* a part of its constitution.

The New Atlantis was first published by Rawley, Bacon's secretary-chaplain, in the year after Bacon's death. From Rawley's description of the fragment it is evident that Bacon intended it to be the introduction to an imaginary picture of his college of research in practical operation to make organized knowledge "proficient" to the regeneration of human society—the *Aedes Salomonis operans.*

We have not time here to describe this book, beyond pointing out the fact that it is *not* the weak imitation of the *Utopia* that our proneness to compute antiquity backwards makes it appear.

Bacon's project, however, was not destined to bear fruit in the way its author planned. It has never been actually realized. But in the inscrutable providence of science it was destined to fructify centuries later in the activities of organizations like that which brings us together this afternoon.

About fifteen years after Bacon's death a group of "divers worthy persons inquisitive into Natural Philosophy and other parts of Humane Learning, and particularly what has been called the New Philosophy" . . . began "by agreement to meet weekly in London to treat and discourse of such affairs."

may contradict received truth, and for the good of society these discoveries must be held back until such time as the world can bear their light, by recording them in a cipher (probably the Bi-Literal), the key to which is to be transmitted to posterity through a line of trusted heads of the college who are in the secret.

One of these enthusiasts was Dr. John Wallis, later Savilian professor of astronomy in Oxford. Wallis was especially interested in the scientific study of philology, and in 1653 published his *Grammatica Linguae Anglicanae,* still one of our most valuable sources for an accurate knowledge of seventeenth-century English phonology. The sub-title of this work is significant — *Tractatus Grammatico-Physicus* — clearly recognizing as it does the fact that the phenomena of speech are subject to physical laws.

It is Wallis who has preserved for us the interesting record of the proceedings of this infant scientific society from which we are quoting.[5]

The weekly meetings were often held, Wallis says, at Mr. Goddard's lodgings in Wood Street, because Goddard employed a man to grind glasses for telescopes and microscopes, then becoming useful tools for scientific investigation. The business of the meetings, we are told, precluded theology and politics, and was devoted solely to the scientific discussion of such topics as "the circulation of the blood," "the lymphatic vessels," "the Copernican hypothesis," "the satellites of Jupiter," "the spots in the sun," "the improvement of telescopes," "the weight of air," "the possibility or impossibility of vacuities," "the descent of heavy bodies and the degrees of acceleration therein"—"with other things pertaining to the new philosophy."

The hypotheses indicated by these titles are the foundation stones of our modern scientific research. Some of them were laid by the original members of the new society; others were new points of view which the world was still prejudiced against and "with loud clamor hooted their projectors."

> About the year 1648 some of our company being removed to Oxford . . . those in London continued to meet there as before; . . . and those of us in Oxford . . . continued such meetings in Oxford and brought those studies into fashion there.
>
> After the King's return in 1660, the London meetings were increased with the accession of diver's worthy and Honorable Persons; and were afterwards [the exact date is 15 July, 1662] incorporated by the name of the *Royal Society &c.* ["for the improving of Natural Knowledge by Experiments," as the charter completely styles the new organization] and so continue to this day.

The first proceedings were published in March, 1664, under the title "Philosophical Transactions," with the distinct *caveat* that the society was not responsible for the views expressed by its members.

[5] It appears among certain autobiographic notes which in the form of a letter to Dr. Thomas Smith are included in Appendix XI to the preface of Hearne's edition of "Peter Langtoft's Chronicle" (1725). The passage relating to the Royal Society is also found in the later editions of Wallis's "Grammatica."

The first volume of these transactions makes interesting reading to-day. It shows that one of the most active pioneer members, besides the philologist, John Wallis, was Mr. Robert Boyle, who in his letters refers to himself as also a member of the "invisible college," probably the Rosicrucian offshoot of the New Philosophy, composed originally of scientific men bound together as an esoteric sodality without name or meeting place and having for its sole end the alleviation of the physical and spiritual ills of humanity.

It seems that at first Sir Isaac Newton held somewhat aloof from the infant Royal Society. They appear, however, to have felt that they could not get along without him, and in January, 1671 (O. S.), he was elected a fellow and accepted the honor.

But difficulties soon arose with the secretary, Oldenburg, in connection, apparently, with some disposition to criticize Newton's new theory of light. On the 8th of March, 1673, Sir Isaac writes a tart note to the secretary saying that he desires "to be put out from being any longer fellow of the Royal Society" on the ground that "the connection is not profitable to either party."

The society then offered to excuse him from paying his dues, a proffer which Sir Isaac, in his reply to the letter announcing the action, affects to consider immaterial.

In 1675 the matter seems to have been satisfactorily adjusted and Newton is reenrolled as a fellow. But evidently peace did not last long, and the controversy over his theory of light did not subside; for in 1676 he writes to the secretary saying that 'he will resolutely bid adieu to philosophy eternally, excepting what he does for his private satisfaction or leaves for publication after his death; for he sees that a man must either resolve to publish nothing new, or spend his whole life in defending his hypothesis.'

Fortunately for the world, he later revoked his decision and from 1703 to his death was president of the organization which published his *Principia*.

I have dwelt on these excerpts from the early minutes of the Royal Society because they are so eloquent of the personal equations involved in bringing scientific men together for what Bacon calls "intelligence mutual, contract, fraternity, and conjunction of labors."

The subsequent history of the Royal Society and later similar organizations like our own is in large part the history of the "proficience and advancement of learning," and I hope our brief computation of antiquity forwards will have made evident that in one sense we are this afternoon really celebrating the 300th birthday of the "able and sufficient" parent of the American Association for the Advancement of Science.

PURDUE UNIVERSITY MARK H. LIDDELL

THE TERMINOLOGY OF CERTAIN PHYSICAL AND BIOLOGICAL EFFECTS OF LIGHT

IN any discussion of the nomenclature of matters pertaining to light one must first make clear what he means by the term light. For there are several definitions extant in illuminating engineering and other literature. In the present case I shall define light as electromagnetic radiation of such wavelength that it may effect adequate stimulation of the sense of sight.[1] Or, light is photic radiation, where photic means effective in producing the sensation of brightness contrast. In this definition light has an objective reality, as all measurable things in physics have. To bring out clearly what the present usage[2] of the term radiation is and how the above definition of light is related thereto I am giving the chart of Fig. 1.

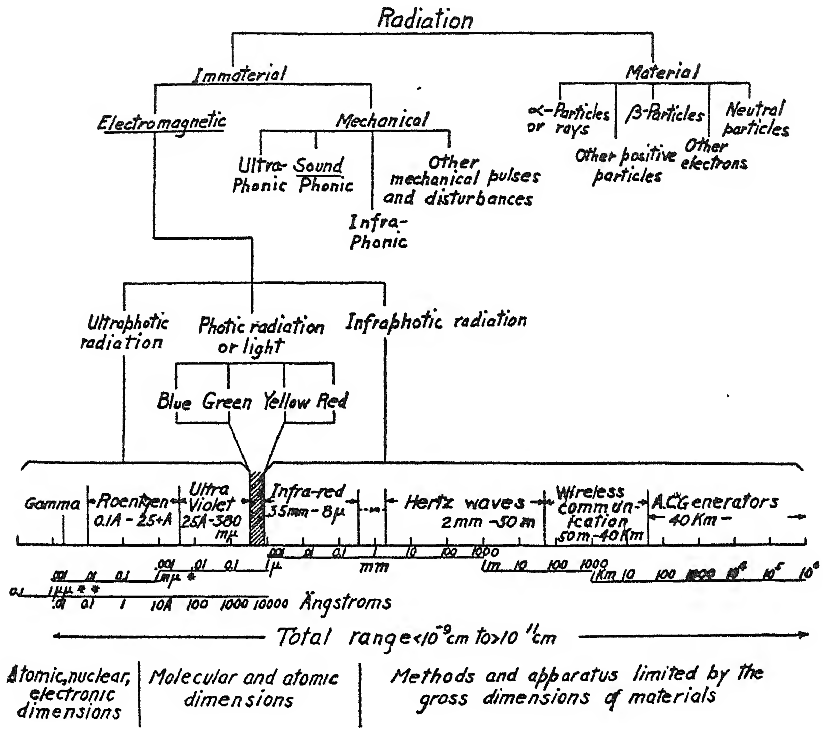
When one surveys the effects of light he finds that there is a considerable confusion of terminology, leading in some cases to an actual confusion of the phenomena. This results in some instances from a lack of short connotative words. The purpose of this note is to point out how a few of these shortcomings in nomenclature may be rectified. For example, the term phototropy has a meaning in zoology different from that in physics. In fact, this word has two different meanings in each of these two sciences. The word photolysis has had a meaning in botany different from that in chemistry.

To make certain suggestions regarding this matter clear and yet succinct, the chart of Fig. 2 is given. Here the various effects of radiation are enumerated and the effects of light are there also as effects of radiation of particular wavelengths. The gross classification into the physical, the chemical and the biological is conventional, having practical but no logical significance. When more shall have been learned about the effects, a better classification no doubt may be had by ignoring this convention. It must be obvious to every one that such a classification has always fringes where the subject-matter may not be clearly demarcated. Some effects are indicated under more than one class, and many others might have been or will be probably as data are accumulated.

The first items for consideration as new suggestions are the terms describing the electrical effects. The phenomenon referred to sometimes as the electromotive force due to light I have termed photovoltic. Certain substances like silver sulphide will, when made a part of a metal circuit, exhibit a difference of potential between illuminated and unilluminated

[1] For other definitions of light see Trans. I. E. S. 1918 and 1922. For a discussion of the definition given above see J. Fr. Inst., 1923.

[2] This matter will be discussed in greater detail in another paper.



* Frequently, especially in older literature μμ
** Sometimes ψμ, recently.

Fig. 1 Chart showing what the concept radiation implies and how the concept light is related to it

portions. Many solutions into which electrodes are immersed will do this, notably cuprous oxide in saline solutions, when one electrode is illuminated. The term photovoltic has obvious advantages over other more lengthy phrases or terms. It will not be confused with the word photovoltaic that has been used (but very infrequently) to denote a change of resistance of selenium when illuminated. For this last effect the term photohmic is reserved. In these two cases at least we find that the use of the name of the unit of resistance and of the unit of potential results in short euphonic and connotative words; and one is inclined to press this method of word formation to other cases. For instance, a change in inductive capacity due to light may be referred to as a photohenric effect. Here we may actually avoid a possible confusion with the phenomenon of the induction period in photochemistry, although the term may not pass as euphonic as the two above.

The ordinary Hallwacks effect (emission of electrons from illuminated metals) is usually called the photoelectric effect, although it might more appropriately be called the photoelectronic effect. Yet the term photoelectric having been so commonly used will cause no confusion if it be allowed that the term photoelectrical have a more general meaning, as indicated in the chart. Certainly, a term of quite general meaning is desirable here. Other effects named in the chart as photoelectrical are self-explanatory; such as photoionic (*e.g.*, in gases), and magnetic induction. The latter refers to such effects as are taken advantage of in radio communication and do not interest us from the standpoint of light. The precipitation of colloids by light is due to the formation of charged particles so that one may wish to insert it elsewhere.

For completeness the photo-magnetic effects now appearing in the literature should be inserted under the electrical group.

Under the optical effects photallochromy is suggested as a substitute for phototropy. What has actually been classified as phototropic heretofore are effects due to light which change the physical state of a body such as to cause the body to appear of different color. Now a body may be changed physically without a change of color, and there are other ways in which such changes may be detected. The allotropic changes and color changes may have no relation to each other and the nomenclature should differentiate between the two sets of effects. Examples of allotropic changes due to light are the change of yellow into red phosphorus, oxygen into ozone, soluble into insoluble sulphur.

To take cognizance of the color changes which

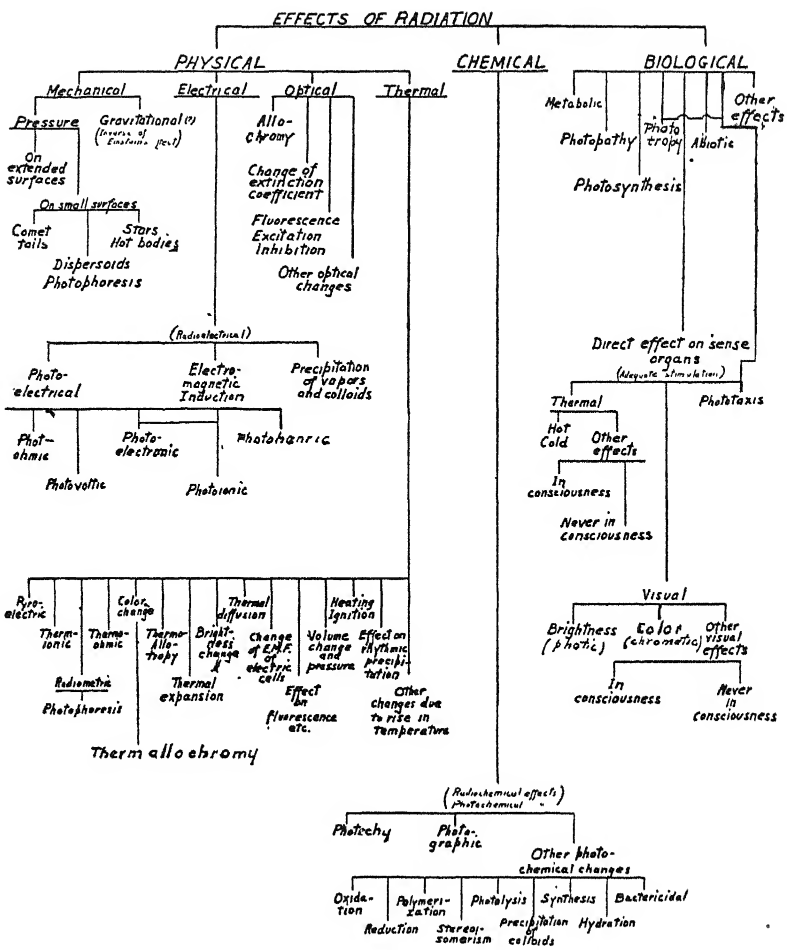


Fig. 2. Chart of effects of radiation

bodies and substances undergo when subjected to different environments the term allochromy is suggested. Accordingly photallochromy (as in phosphorus) is under optical, while thermallochromy (mercuric iodide) lies under thermal effects. Incidentally, this term lends itself well to all such other changes of color as are caused by crushing (piezzallochromy), and even by chemical reactions (chemallochromy) or those brought about in organisms (bioallochromy). Photallochromy has recently received considerable attention in connection with the lighting of museums, where the fading of specimens due to light is a serious matter.[3] The general phenomenon of allotropic changes due to radiation is placed under chemical effects.

Most of the new terms under thermal effects will now also be clear. Instead of the term pyroelectric the term pyrovoltic may be used in accordance with the terms suggested and discussed under electrical effects.

Under the chemical effects no suggestions are offered. For a most excellent detailed classification here reference may be made to Plotnikow in his "Lehrbuch der Photochemie."

Certain points for discussion arise in connection with the biological group. The word phototropy may be retained here since it has been entirely deleted from the physical and chemical groups. Yet with its duplicity of meaning in zoology it might be questioned whether or not it is retainable with clarity to designate one specific phenomenon as the botanists have it, and whether it had not rather be relegated to the indefinite and popular usage where its various meanings may be retained without serious consequences. Botanists and zoologists recognize a large number of reactions known as tropism. These are described by various affixes as rheo, geo, photo, rheostich,[4] chemo and others. It may be convenient

[3] Ill. Engr. (London) 15, p. 308, 1923.

[4] The word rheostichotropism (stream, line, adjustment) was coined to designate the structural adjustment in organism toward streamline contours. See Jour. Franklin Inst. p. 737, 1923. Inadvertently the middle root was deleted in the galley proof and the word ap-

therefore (and I wish for the present) to retain the word phototropy in its most usual botanical sense.

In this sense phototropy refers specifically to the orientation by organisms in response to an intensity gradient. There is another set of reactions closely related to the phototropic, known as phototactic, in which preference is shown for light of either greater or less intensity without immediate reference to orientation. It is aside the present purpose to discuss the relationship between the two. The two kinds of phototactic reactions, according as the preference is for and the movement into regions of greater or less intensity, may be referred to as photophilic and photophobic, respectively. The two phototropic reactions may be distinguished by the prefixes dia and para according as the orientation is such as to allow a maximum or minimum of radiation to be *effectively* absorbed.

In botany there are other photic effects which I have not enumerated; such as phototonic, photoclistogamic, photoauxesis, photoperiodism, photolysis, and certain others which upon close inspection may possibly be classified—as particular aspects of phototropism or some other effect. These bring along no inconsistencies—only for the term photolysis it is suggested that the meaning given by the chemist be the recognized one (*viz.*, dissolution or solution of cells or substances).

I am suggesting the use of the term photopathy in a rather general sense and with a connotation that is suggested by the root *pathos* when used in such a word as pathology. Photopathy then includes such effects as photomania, photalgia, photerythema, photoncia (swelling), photoptarmosis (sneezing). An independent position should perhaps be given in the chart to photomorphosis or photomorphism for the structural effects in organisms due to light.

Through this note I hope that an impetus may have been given to those who are interested in the various effects of radiation, and of light—photochemical, photophysical and photobiological—to give some attention to certain matters of nomenclature that may result in clarity and unity of usage in the widely separated branches of science. It is hardly to be expected that my first suggestions given above on such matters of nomenclature will be equally satisfactory to the botanist, the zoologist, the chemist and the physicist, and shall we say, the pathologist or the phototherapist.

DR. ENOCH KARRER

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pears as rheotropism which has already a well established meaning in zoology different from that intended here. A more desirable word it now seems to me is *rheomorphism*.

THOMAS CORWIN MENDENHALL

T. C. MENDENHALL, as he always signed himself, had a special talent as an educator, a valuable and rather rare gift, and with this he had a strong interest in scientific knowledge, and tireless energy in seeking it. Without the advantage of a college education himself, his ability and industry were such that at the age of 32 he was the first member elected to the first faculty when what is now the Ohio State University was founded in 1873. His steadfast devotion to education is shown by the fact that just 50 years later, when living in retirement, he was selected as the president of the board of trustees of this same university, and he was serving actively in this capacity at the time of his death on March 22 last at Ravenna, Ohio. He was born in the neighboring town of Hanoverton, October 4, 1841, and thus lived to the good age of over 82 years.

Dr. Mendenhall's success in educational work was due to clearness of expression and aptness of illustration, charm of manner and interest in men, as well as in his love of knowledge and of making it useful to others. After preliminary training as a teacher, he became the first professor of physics in the Ohio State University, and served in this capacity for five years. At this time scientific education in the United States was in an early stage and Dr. Mendenhall exerted an important influence in its development in the middle west. He refers to the period as one "when those engaged in scientific research even for a very small portion of their time were but a handful." An associate of those days writes "he was full to overflowing with the purpose to do his share in giving to science study its deserved place in public schools and placing it upon the proper plane in colleges." When Japan determined to develop a great university at Tokyo she called for help from England and America, and Professor Mendenhall was one of a group of able men invited. He went to Japan in 1878 as professor of physics in the Imperial University, and remained three years. He then returned to the Ohio University. Later, after service with the government, he was president for several years of the then recently organized Rose Polytechnic Institute, and again after another term of public duty, he was president for seven years of the Worcester Polytechnic Institute, from which he retired in 1901. Thus in the educational field he organized the departments of physics in two universities, was president of two engineering colleges, and closed his career as a trustee of his state university. His students remember his clear exposition, his kindly interest and his helpful practical advice; his stimulating influence affected the future of many men. When Dr. Mendenhall retired from the Rose

Polytechnic Institute in 1889, the student body united in a tribute of affection and appreciation.

Although he commenced and closed his career in educational work, three times returning to it, Dr. Mendenhall's life was filled also with other activities having to do with science and engineering, in which he showed his ability for organization and administration, and his interest in science and its application. He was for five years Superintendent of the Coast and Geodetic Survey, and a mere list of his other assignments shows the range and extent of his activities over a number of years. He was a professor in the U. S. Signal Corps for several years engaged in investigations of atmospheric electricity, a member of the Lighthouse Board, a member of the first Bering Sea Commission, a member of the United States and Canadian Boundary Commission, a member of the Massachusetts Highway Commission, a United States delegate to the International Electrical Congress in 1893, president of the American Association for the Advancement of Science, president of the American Metrological Society, Superintendent of the Office of Weights and Measures, first chairman of the U. S. Geographic Board, vice-president of the Cosmos Club, the Scientific Club of Washington, and a member of the National Academy of Sciences and of many other organizations. This list illustrates his willingness to serve the public, and his active participation and fellowship in the organized efforts of scientific men. He left Washington thirty years ago, after some very active years, and those who knew him in those days remember his many-sided interest in scientific endeavor, and particularly his clear and pleasing addresses, always making his subject entertaining by apt illustration. During one period Dr. Mendenhall's courage in following high ideals of public service was shown by the sacrifice of his own interests and comfort in resisting demoralizing small politics in government administration; subsequent events confirmed the correctness of his course.

While connected with the University of Tokyo, Professor Mendenhall made a measurement of the absolute force of gravity at Tokyo, and later, in 1880, measured the relative force of gravity between Tokyo and the summit of Fujiyama by swinging an invariable pendulum at the two places, and from this made a computation of the mean density of the earth. While more precise determinations of this constant have been obtained by other methods, this measurement was the best of its kind. Some years later, when Superintendent of the Coast and Geodetic Survey, he was mainly responsible for the development of an improved portable apparatus for the measurement of the relative force of gravity by means of half second pendulums, which apparatus greatly increased the accuracy and facility of such determinations, and he planned the first extensive use of the apparatus in a transcontinental series of gravity measurements in 1894, and arranged for the cooperation of an eminent geologist in this work. It is substantially this apparatus which has been employed in the investigation of the condition of the earth's crust made in this country and elsewhere, in the years since. He first proposed the use of a ring pendulum for the absolute measurement of the value of the acceleration of gravity, a method which besides being of scientific value, is used in college laboratories.

Dr. Mendenhall was one of the American delegates to the International Electrical Congress in 1893, and took an active part in that gathering of eminent physicists from various countries, which resulted in the adoption of definitions for the electrical units; the original draft of these definitions, in his handwriting, is in the archives of the Franklin Institute.

In 1885, a few months after its completion, the Washington Monument was struck by lightning and seriously injured. Mendenhall, then in charge of the physical laboratory of the Signal Corps, after investigation in cooperation with Rowland, devised the scheme of protecting the monument from lightning, which has been successful.

The versatility of his interest is shown by his study of characteristic word lengths of various writers, and he originated the idea of using curves for this purpose, which curves he showed were distinctive for various authors, but practically constant for one writer.

Dr. Mendenhall was a contributor to scientific periodicals and reports, and published a small volume, "A Century of Electricity." His writings were clear and pleasing. He always sought to popularize science and to bring it to a wider circle, but never to lower its standards or ideals.

For some years he was compelled by ill health to rest in Italy, but with methodic effort and endless patience, he again built up his physique, so that he was able to return to his native state. In his later years of retirement in Ohio, in addition to his renewed connection with the university, he was an active voluntary worker among the children of his town, taking pleasure in instructing them in the rudiments of science.

Dr. Mendenhall received a number of honors and medals, both in this country and in Japan. On the presentation of the medal of the Franklin Institute to him in 1918 in recognition of his labors in physical research, it was said that "he is a typical American in that he found and created his own opportunities and indefatigably always gave the best that was in him to serve his fellows and his country."

GEORGE R. PUTNAM

SCIENTIFIC EVENTS

PROGRESS IN PREPARATION OF INTERNATIONAL CRITICAL TABLES

INTERNATIONAL CRITICAL TABLES, organized under the auspices of the International Research Council, is a portion of the international scientific program, the responsibility for which has been assigned to the United States. The work is in charge of the board of trustees and the board of editors, appointed through joint action of the National Research Council, American Chemical Society and American Physical Society, with headquarters at the National Research Council, Washington, D. C.

The work of preparing the data for International Critical Tables is now actively under way. The material is being collected and critically evaluated by approximately 300 competent experts distributed among the following countries: United States, Canada, Great Britain, Belgium, France, Italy, Austria, Germany, Denmark, Switzerland, Holland, Australia and Japan.

The program covers all available information of value concerning all the properties and numerical characteristics of (a) pure substances, (b) physicochemical systems of definite composition, (c) many industrial materials, (d) many natural materials and (e) selected data for selected natural bodies or systems, such as the earth and its main physical subdivisions, the solar and stellar systems and certain biological organisms, including man. Publications of the world in all languages will be combed for data and much unpublished information is also being collected. In addition to the stupendous scope of the tables, hitherto unapproached by any similar publication, the volumes will contain many novel features of arrangement. Thus, for example, not only will it be possible to find readily all the properties of a given substance or material but it will also be possible in many cases to ascertain readily what substance or material of a given kind has a maximum, a minimum or a given value for any given property. This feature will be of great assistance in identifying a substance by means of its properties or in selecting a substance or material on the basis of a given property or combination of properties. The main descriptive material and the very complex index to the tables will be in four languages, English, French, German and Italian.

In order to assist the board of editors in connection with the work of the cooperating experts in foreign countries and in the collecting of information from these countries, ten corresponding editors have been appointed. These editors have greatly assisted the board in connection with the selection of competent cooperating experts. They have general charge of relations with the experts in their respective countries and also assist the board in securing data from their own and neighboring countries. Following is a list of these editors and their advisory committees:

THE BRITISH EMPIRE (excluding British North America). Dr. G. W. C. Kaye, National Physical Laboratory, Teddington, England. Advisory committee: Sir Robert Robertson, W. Rosenhain, J. E. Sears, T. E. Stanton, W. F. Higgins, A. W. Porter.

BRITISH NORTH AMERICA. Dr. Otto Maass, department of chemistry, McGill University. Advisory committee: J. W. Bain, R. J. Durley, A. L. Hughes, G. S. Whitby.

JAPAN (and eastern Asia). Professor Kotaro Honda, Iron and Steel Institute, Tohoku University, Sendai, Japan.

BELGIUM (and its dependencies). Professor M. Strauven, Liége, Belgium.

HOLLAND (and its dependencies). Dr. W. J. van Heteron, Utrecht, Holland. Advisory committee: Ernst Cohen, C. A. Crommelin, H. Baucke.

DENMARK (Norway and Sweden). Professor Dr. Niels Bjerrum, Copenhagen, K. Denmark. Advisory committee: Martin Knudsen, Carl Jacobsen.

FRANCE (Spain and Portugal). Dr. Charles Marie, Paris, France. Advisory committee: C. Moureu, A. Fabry, A. Guillet.

SWITZERLAND. Professor A. Berthoud, Neuchâtel, Switzerland. Advisory committee: Ch. E. Guye, H. Rupe, F. Schule.

AUSTRIA (central and southeastern Europe). Professor Dr. Rudolf Wegscheider, Vienna, Austria.

ITALY (and its dependencies). Professor Eicola Parravano, Istituto Chimico, R. Universita, Rome, Italy. Advisory committee: Ugo Bordoni, Luigi Rolla, Francesco Giordani.

THE NEW ENGINEERING BUILDINGS OF UNIVERSITY COLLEGE

ACCORDING to the London *Times* the new buildings of the faculty of engineering of University College, London, have just been completed, and will be formally opened in the near future.

Professor Simpson has designed the new wing to harmonize with the existing buildings and Professor Coker and his staff, aided by Sir Ernest Moir and Sir Alexander Kennedy, have given much care to the working out of suitable plans. The main engineering laboratory is equipped to show the best practice in heat engines and provision is made for experiment and advanced research; also for experiment in connection with the testing of materials.

For advanced and post-graduate students, in addition to a laboratory there are available a number of small rooms suitable for research work. Other provision includes an additional electrical laboratory, a large lecture room and a laboratory for the department of municipal engineering. In the basement a

considerable area will be available for the Hawksley hydraulic laboratory. There are well-lighted drawing offices for students on the second floor.

One of the most interesting of the rooms is that devoted to the study and measurement of sound, especially in connection with wireless, cables and telephony, over which Professor J. A. Fleming presides. By means of a delicate instrument it is made apparent that the whole of London is vibrating, a fact due, according to Professor Fleming, to the tube railways.

The reconstruction and reequipment of the engineering buildings has so far cost the authorities of the college £53,500, of which £10,000 has been contributed by the London County Council and £10,000 by Lord Cowdray.

Modern work in industrial chemistry is so intimately connected with engineering that it is proposed to erect, with the aid of a grant of £25,000 from the Ramsay memorial fund, a chemical engineering building to house the equipment and lecture-rooms and give other special accommodation required for this purpose. The department has already made a promising start, and is intended to form a connecting link between the schools of chemistry under the direction of Professor Collie, F.R.S., and Professor Donnan, F.R.S., and the engineering school.

THE SECTION OF PSYCHOLOGY OF THE BRITISH ASSOCIATION

OVERSEA members of the British Association for the Advancement of Science coming to the Toronto meeting, beginning August 6, include the following:

President of Section J—W. McDougall, professor of psychology, Harvard University. Late reader in mental philosophy, Oxford. In his presidential address he will deal with "Purposive action as a fundamental conception in psychology," and will deliver a lecture on "Human heredity and national (or racial) outlook."

Vice-President—Cyril Burt, of the department of education, London County Council. Speaks on "Tests for scholarship and promotion."

Recorder—L. Wynn-Jones, Harrogate.

Secretary—R. J. Bartlett.

Secretary—Shepherd Dawson, Glasgow.

F. A. Aveling, reader in psychology, University of London. General secretary of the British Psychological Society. Will speak on the "Standpoint of psychology."

F. C. Bartlett, professor of experimental psychology, Cambridge.

William Brown, Wilde reader in mental philosophy, Oxford.

H. Wildon Carr, professor of philosophy, University of London, editor of proceedings of Aristotelean Society.

J. Drever, reader and lecturer in psychology, University of Edinburgh, will speak on "Psychological theories of laughter."

J. C. Flügel, senior lecturer in philosophy and psychology, University College, London, will discuss "Feeling and emotion in daily life."

B. Hart, physician in psychological medicine and lecturer in psychiatry in University College Hospital Medical School, London.

Dr. J. T. MacCurdy, formerly of Toronto and Cornell, now of Cambridge.

C. S. Myers, director of the National Institute of Industrial Psychology, editor of the *British Journal of Psychology*, presents a paper on the "Conception of fatigue," in the joint discussion between physiology and psychology sections dealing with "Physiological factors of muscular efficiency in industry."

T. H. Pear, professor of psychology in the University of Manchester.

C. E. Spearman, Grote professor of mind and logic, University of London.

SCHOOL OF HYGIENE IN THE UNIVERSITY OF TORONTO

ON May 20, the International Health Board of the Rockefeller Foundation approved of a proposal to assist financially in the creation and endowment of a school of hygiene in the University of Toronto; and the following day the Rockefeller Foundation pledged $650,000 to the governors of the University of Toronto, for this purpose. The governors of the university have accepted the proposals and the above-mentioned sum will be utilized to provide a building to cost not more than $400,000; the remaining $250,000 will be used for the endowment of the school. While final details of organization remain to be perfected, the school will include the departments of hygiene and preventive medicine and public health nursing and the Connaught laboratories. The operating or public-service divisions (namely the antitoxin and insulin) of the Connaught laboratories will be merged and constitute a public service section in the school.

The endowment will be added to by the inclusion of the resources of these laboratories, namely the Connaught laboratories research fund. The governors of the university have agreed to maintain the building and continue to sustain the budgets appropriated for 1924–25, for the maintenance of the teaching departments of hygiene and preventive medicine and public health nursing.

APPOINTMENTS AT THE ROCKEFELLER INSTITUTE

THE board of scientific directors of the Rockefeller Institute for Medical Research announces the election of Dr. Francis Gilman Blake as a member of the board of scientific directors to succeed Dr. Hermann M. Biggs, deceased.

The following promotions and appointments are announced:

Promotions:

Associate Member to Member:

Dr. James B. Murphy
Dr. John H. Northrop

Associate to Associate Member:

Dr. Thomas M. Rivers

Fellow to Assistant:

Miss Gladys Bryant
Dr. Charles Korb
Miss Dorothy Loomis
Dr. Elmer L. Straub

Dr. William S. Tillett has been appointed resident physician at the hospital.

New Appointments:

Assistants:

Dr. Douglas Boyd
Dr. Clifford L. Derick
Dr. Louis A. Julianelle
Dr. Ann G. Kuttner
Dr. John F. McIntosh
Mr. Bernard J. C. Vander Hoeven

Fellow:

Dr. David Davidson

Dr. Paul E. Howe, hitherto an associate in the department of animal pathology, has accepted an appointment with the division of animal husbandry, Bureau of Animal Industry, U. S. Department of Agriculture, in charge of nutrition investigations.

Dr. George R. Brow, hitherto an assistant in the department of the hospital, has accepted an appointment as research assistant at the University College Hospital, London, under Sir Thomas Lewis.

Dr. Geoffry C. Linder, hitherto an assistant in the department of the hospital, has accepted an appointment at St. Bartholomew's Hospital, London, under Professor Francis R. Fraser.

Dr. Hugh J. Morgan, hitherto an assistant and resident physician at the hospital, has accepted an appointment as associate professor of medicine at Vanderbilt University.

Dr. James M. Neill, hitherto an assistant in the department of the hospital, has accepted an appointment as associate professor of bacteriology at Vanderbilt University.

Dr. Harold A. Salvesen, hitherto an assistant in the department of the hospital, has accepted an appointment as chief of clinic at the Physiologic Institute, University of Christiania, Norway.

SCIENTIFIC NOTES AND NEWS

Dr. Robert Simpson Woodward, president of the Carnegie Institution from 1905 to 1920, and formerly professor of physics in Columbia University, died on June 29, at the age of seventy-five years.

Dr. Adriaan van Maanen, of Mount Wilson Observatory of the Carnegie Institution, has been elected correspondent of the Royal Academy of Sciences at Amsterdam.

Professor E. Bataillon, of the University of Montpellier, has been elected associate of the Royal Academy of Belgium, in succession to the late Dr. Jacques Loeb.

The University of Chicago has conferred the Rosenberg medal upon Dr. Frederick G. Banting, of Toronto. This medal is awarded annually by the university to the person conferring the greatest benefit upon humanity.

The Helmholtz gold medal, awarded once in ten years by an international committee for the most significant research in the domain of optics, has been given to Professor K. von Hess, of Münich, for his investigations on color vision.

Sir Ernest Rutherford has been appointed by the University of Cambridge delegate to the Franklin Institute on the occasion of its centenary next September.

The University of Colorado at its recent commencement conferred the honorary degree of doctor of science upon Professor William Duane, of Harvard University.

Dr. Ray Lyman Wilbur, president of Leland Stanford University, has received the honorary degree of doctor of science from Syracuse University.

The University of Aberdeen has conferred upon Sir Henry Gray, head of the surgical division of the Royal Victoria Hospital, Montreal, the honorary degree of LL.D.

Dr. Albert Ernest Jenks, professor of anthropology, University of Minnesota, and chairman of the division of anthropology and psychology, National Research Council, delivered an address on "The dawning era of science" at the seventieth annual commencement of Kalamazoo College, June 18, on which occasion the college conferred on him the honorary degree of doctor of science.

A correspondent writes that Professor F. X. Schaffer, of the Naturhistorisches Staatsmuseum, Vienna, will arrive in the United States during the summer and will spend the remainder of the year traveling in various parts of the country. He is prepared to give lectures on the more recent interpretations of the Pleistocene of Europe.

Professor W. A. Noyes, of the California Institute of Technology, has given lectures in England at the Universities of Oxford, London, Cambridge and Manchester and in Germany. He will continue his

lecture tour through Switzerland and Denmark and expects to leave for the United States about the middle of August.

HENRY C. FULLER, of the Institute of Industrial Research, Washington, D. C., is now in Europe to attend the fourth congress of industrial chemistry at Bordeaux, France, as a delegate from the American Chemical Society. As a representative of the National Research Council, he also attended the meeting of the International Union of Pure and Applied Chemistry, which convened at Copenhagen, June 26 to July 1.

DR. G. BREIT has resigned his position as assistant professor of physics at the University of Minnesota to accept an appointment as mathematical physicist in the department of terrestrial magnetism of the Carnegie Institution of Washington, effective July 1, 1924.

DR. HARRY PLOTZ, of New York, has been appointed a member of the staff of the Pasteur Institute, Paris.

JAMES F. NORRIS, professor of chemistry at the Massachusetts Institute of Technology, is to be chief of the division of chemistry and chemical technology of the National Research Council, beginning July 1, 1924. He succeeds J. E. Zanetti, who returns to Columbia University next fall. Professor Joseph S. Ames is to be chairman of the division of physics, and Dr. David White, of the U. S. Geological Survey, will head the division of geology.

H. F. JOHNSTON, on May 1, assumed charge of the magnetic observatory at Watheroo, Western Australia, of the Carnegie Institution of Washington, in succession to Dr. G. R. Wait, who resumes his duties in the department of terrestrial magnetism at Washington.

DR. ROBERT W. LOVETT, professor of orthopedic surgery at Harvard Medical School, died July 2, aged sixty-four years, in Liverpool, England, at the residence of Sir Robert Jones.

THE death has occurred in his seventy-second year of Sir James Dobbie, until a few years ago principal of the government laboratories, London, and known for his work on the chemical constitution of the alkaloids.

DR. ARNOLD PICK, emeritus professor of psychiatry in the university at Prague, has recently died at the age of seventy-five years.

DR. G. H. BAILEY, advisory chemist of the British Aluminium Company, noted for his work on the corrosion of metals and for his text-books on inorganic chemistry, died recently at the age of seventy-two years.

DELEGATES to the International Mathematical Congress to be held in Toronto, August 11 to 16, have been appointed by the universities and scientific institutions and societies from a number of countries as follows: United States 59, Canada 6, Great Britain 28, British Dominions other than Canada 3, France 11, Belgium 3, Italy 4, Holland 2, Spain 1, Roumania 1, Czecho-Slovakia 2, Norway 2, Sweden 1, Russia 2, Chili 1, Argentina 1, Mexico 1.

THE Northwest Association of Horticulturists, Entomologists and Plant Pathologists will hold its seventh annual meeting at Penticton, British Columbia, August 26 to 29, 1924. The membership of this association includes those interested in the three sciences in the states of Oregon, Washington, Idaho, Utah and Montana and in the province of British Columbia. The Pacific division of the American Phytopathological Society will also hold its annual meeting at the same time and place.

ACCORDING to information published by the International Labor Office, the first international meeting for the study of problems of industrial hygiene will be held in Geneva, Switzerland, July 18 to 20. The Swiss organizing committee in charge of the meeting announces the following subjects for the meeting and papers to be read: Industrial lighting and eyestrain, with papers as follows: Technical report, Mr. Gaster, London; "General physiopathology," Mr. Oblath, Trieste; "Lighting in mines and miner's eyestrain," Dr. Stassen, Liége. Vitiated atmosphere in workshops, with papers as follows: "Ventilation," Professor L. Hill, London; "Dust and smoke," Mr. Kohn-Abrest, Paris; "Gases," Professor Lehmann, Wurzburg. Value of fatigue tests, with papers as follows: "Chemical methods—general criticism of fatigue tests," F. S. Lee, New York; "Mechanical and graphical methods," Professor Patrizi, Bologna; "Psychological methods," Dr. Wyatt, London.

A SERIES of medical lectures will be given at the University of Washington during the week of July 14 to 18. Sir John Herbert Parsons, of the Royal Ophthalmological Hospital of London, England, will lecture on ophthalmology. Dr. John Osborn Tolak, of Chicago, will lecture on obstetrics and gynecology, and Dr. Elliott P. Joslin, of the Harvard Medical School, will lecture on diabetes.

AT the Second National Colloid Symposium held at Northwestern University, a movement was started with the approval of the National Research Council and the National Academy of Science, to raise an endowment of $1,000,000 for a national institute of research in colloid chemistry.

THE province of Ontario is to contribute $125,000 for the new forestry building at McGill University.

At the annual convention of the American Association of Nurserymen in Atlantic City, $1,500 was appropriated in appreciation of the invaluable services of Professor C. S. Sargent and the Arnold Arboretum to American horticulture in introducing the finest hardy plant materials of the world. The presentation was made by E. H. Wilson, of the Arboretum.

The University of Cambridge has received £5,000 through the gifts of Mrs. Pinsent, Sir Horace Darwin and the Hon. Lady Darwin, for the purpose of promoting research on problems which may have a bearing on mental defects, diseases or disorders. The benefaction is to form a fund to be called the "Pinsent-Darwin fund," and the income is to be applied to endow a studentship in mental pathology.

The board of regents of the University of Minnesota have appropriated the sum of $35,000 for the construction of a new greenhouse system for the department of botany. The houses, serving for the production of illustrative materials and for research, will be constructed during the coming summer.

At a meeting of the College of Physicians, of Philadelphia, June 4, Dr. W. W. Keen presented a portrait of Dr. William J. Taylor on behalf of his friends; Dr. William H. Welch, Baltimore, transferred the custodianship of the Cabinet of Historic Medical Mementos to Dr. Keen, who made also the presentation on behalf of Sir W. Hale White, president of the Royal Society of Medicine, London, of a facsimile of notes on lectures on anatomy in Guy's Hospital in which John Keats was a dresser in 1816.

Dr. Leon J. Cole, chief of the division of animal husbandry of the Department of Agriculture, and Mr. Edward N. Wentworth, director of Armour's Livestock Bureau, Chicago, are on a visit to Copenhagen as representatives of the United States government to study Danish cattle and pig-breeding methods. They will subsequently visit Holland, London and Edinburgh.

Roald Amundsen, explorer, who has been preparing for an airplane expedition to the North Pole, has announced that the trip has been postponed because of economic difficulties.

The approaching opening of the Waite Institute, South Australia, founded with a bequest left by Mr. Peter Waite, will initiate important developments in scientific and agricultural research in the southern hemisphere. The work, which is to be under university auspices, will be carried out on a large estate near Adelaide, which formerly belonged to Mr. Waite. There is a fine residence which is to be used for the institute. Dr. Richardson, a South Australian, at present dean of the faculty of agriculture, and superintendent of agriculture in Victoria, has been appointed director. The institute, which is to be unique in its scope, size and equipment, will have an assured annual income of £8,000.

An exposition of inventions is to be held, December 8 to 13, 1924, in the Engineering Societies Building, New York City. The American Institute of the City of New York is handling this display through its inventors' section. A feature of the exposition will be exhibits from the leading American industries showing developments of various machines, utilities and processing methods. In all fields the ingenuity of the inventor and the part he has played in the progress of America will be emphasized.

The Canadian government ship "Arctic" left Quebec July 5 to carry a party of scientists on a trip of exploration along the upper shores of Hudson Bay, chiefly to make studies of atmospheric conditions for use in weather forecasting. F. D. Henderson, of the Department of the Interior, and J. D. Soper, meteorologist, will direct the party of forty-five. Captain J. F. Bernier, who has sailed the vessel on similar Arctic voyages for twenty years, will command. The "Arctic" will carry provisions for remote outposts of the Mounted Police, which will be increased. Some of the outposts will be made permanent weather stations.

A protest filed by the United States Bureau of Fisheries against the proposed hydro-electric plant on Baker River, Wash., has, it is announced, been withdrawn, on the promise of Stone & Webster, who are to erect the plant, to construct a pond below the dam where the bureau can place adult salmon taken while on their way to the spawning grounds on Baker Lake and determine whether a hatchery can successfully be maintained at the artificial pond. A fish ladder to enable the salmon to ascend the obstruction has been held to be impracticable.

UNIVERSITY AND EDUCATIONAL NOTES

At the recent centennial commencement of Kenyon College, Ohio, it was announced that H. G. Dalton had donated to the college funds for a new science building. While no amount was specified in the gift, the cost of the building and equipment will be approximately $200,000.

Rutgers College receives a bequest of $25,000 under terms of the will of Sarah W. De Witt, of Albany, N. Y.

A donation of $75,000 has been made to Indiana University, Indianapolis, by Mr. and Mrs. William

Coleman for the school of medicine. The gift is in the form of a memorial to their daughter and will be used to endow the chairs of ophthalmology, surgery and gynecology.

ANNOUNCEMENT has been made of the gift by the Carnegie Corporation of $20,000, annually for two years, to the University of Louisville medical department, while plans are being perfected for raising an endowment fund. The added income will be used largely in developing the department of pediatrics.

CAMBRIDGE UNIVERSITY receives by the bequest of the late Mrs. Constance Jenkinson £2,216 for the purpose of founding a lectureship for the encouragement and advance of research in comparative and experimental embryology in the university, to be called, in memory of her late husband, the John Wilfred Jenkinson Memorial Lectureship.

DR. CHARLES K. EDMUNDS, for the last fifteen years president of Canton Christian College, China, was installed on July 1 as provost of Johns Hopkins University. Dr. Edmunds is an alumnus of Johns Hopkins and for eleven years was in charge of the Carnegie Institution's magnetic survey of the China coast.

DR. WILLIAM H. S. DEMAREST, president of Rutgers College, has resigned. The dean of the college, Walter T. Marvin, became acting president on July 1.

DR. A. PRINGLE JAMESON has resigned from his position as professor of zoology in Mills College, Oakland, California, and has accepted a lectureship in the University of Cambridge, where he will have charge of investigations on the parasites of domestic animals. Dr. Horace Gunthorp, of the University of Washington, has been appointed as head of the department of zoology at Mills College.

DR. WILLIAM G. SMEATON and Dr. Floyd Bartell have been promoted to full professorships in the department of chemistry, University of Michigan.

DR. SAMUEL C. HARVEY has been appointed professor of surgery at Yale University.

DR. JOHN FAVILL has been appointed clinical professor in the department of medicine at Rush Medical College at the University of Chicago.

AT the University of Minnesota Dr. Karl S. Lashley has been promoted to be professor of psychology.

DR. RICHARD BUETNER, of the University of Leyden, formerly of the Rockefeller Institute, has been appointed assistant professor of pharmacology in the University of Louisville medical department.

DR. EDMUND M. SPIEKER, of the United States Geological Survey, has been appointed assistant professor of geology at Ohio State University.

C. D. HURD, of the University of Illinois, has accepted an assistant professorship in organic chemistry at Northwestern University.

RECENT appointments in the faculty of the University of Arkansas include George C. Fracker, dean of the college of liberal arts of the University of Dubuque, to be professor of psychology and philosophy; Paul A. Cushman, assistant professor in the Brooklyn Polytechnic Institute, to be professor of mechanical engineering; Claud F. Clayton, University of Minnesota, to be associate professor of rural economics.

DR. GLOVER M. ALLEN has resigned as secretary of the Boston Society of Natural History and has been added to the staff of the department of zoology at Harvard University as lecturer on zoology. Dr. Allen will remain librarian of the Boston Society and will also continue his researches on the mammal collections of the Museum of Comparative Zoology.

DR. HARRY SELTZ, instructor at the University of Pennsylvania, has been appointed instructor in physical chemistry at th eCarnegie Institute of Technology in Pittsburgh.

DISCUSSION AND CORRESPONDENCE

THE FOSSIL ELEPHANTS OF MINNESOTA

DURING the last year and a half several very remarkable finds of elephant remains have been made within the state of Minnesota. These consist of parts of the skeleton in almost perfect preservation. The first was discovered while making an excavation for the abutment of a bridge over a new dredge ditch that drains the area south of Blue Earth River, eight miles southeast of the town of Blue Earth, and four miles west of Frost. This area is an old post-glacial lake bed, according to Dr. George A. Thiel, who superintended the removal of the bones, and in which no drift was cut by the ditch. The bones were in clay and sandy layers seven to ten feet below the surface, the upper four or five feet of which pass into a black soil. The skeleton was apparently somewhat scattered as originally deposited, for only a few vertebrae, a half dozen ribs, a radius, the head of a humerus and of a femur, three tarsal bones and various other fragments were recovered. But these are sufficient to show the size of the animal and for its identification, since a comparison of them with the next specimen indicates that they came from an animal similar in every respect.

The second of these recent finds is the best and most complete specimen so far found in the state. It came from Mr. P. D. McMillan's farm in the eastern part of Freeborn County and was found in the superficial deposits of the area which was formerly Rice

Lake. Some years ago this was a swamp and shallow lake area. Here and there wooded knolls and knobs thirty to forty feet above the general level were islands in the old lake. The filling ranges from a fine gravel to sand and clay with a thick muck soil at the top. Within the last few years a large ditch has been dug through this area and it is now completely drained and bids fair to be one of the finest farming sections of the state. Last spring (1923), when the ditch was being widened and deepened, the dredge threw out parts of the skeleton of a mammoth. These attracted the attention of Mr. McMillan, who brought the upper jaw to the University of Minnesota. Further search was then instituted and this resulted in the recovery of about one fourth of the skeleton. The specimen was found in a stiff blue clay about fifteen feet below the surface with no drift above it. Apparently the skeleton was lying crosswise with the ditch, the tusks being out under the bank. It seems that it had not been disturbed since it sank into the soft muds of the lake and probably the balance of the skeleton is still in place. The portions recovered consist of the upper jaw with an excellent pair of teeth, fragments of the pelvis, one femur, two tibias, tarsals, meta-tarsals, phalanges, one humerus, the larger part of one ulna, various fragmentary ribs, fragments of the cranium and tusk sheaths, vertebrae from the neck, back and tail. Measurements of certain of the skeletal elements indicate an animal about eleven feet high, and the teeth exhibit the usual formula for *Elephas columbi* with seven to seven and one half lamellae to one hundred millimeters.

Most of the previous finds have been of the teeth only and these have been so associated with the drift that it was impossible to determine whether they belonged to the glacial or the post-glacial period. These recent finds seem to indicate that the Columbian elephant survived the glacier in Minnesota and that perhaps we may hope to make other even more important finds as the great muskegs and swamp areas of northern Minnesota are drained.

The following is a list of the elephant remains so far known to have been found within the state:

(1) *Elephas columbi*, a tooth from Rock County, Minnesota.

(2) *Elephas columbi* (?), fragments of vertebrae from Kenyon, Goodhue County, Minnesota.

(3) *Elephas columbi* (?), part of the pelvis found in river gravels eight feet below the surface at Red Wing, Goodhue County, Minnesota.

(4) *Elephas columbi*, a tooth from the river gravels near Red Wing, Goodhue County, Minnesota.

(5) *Mastodon americanus* (?), a vertebra "found in a bed of coarse gravel eight feet below the surface," at Owatonna, Steele County, Minnesota.

(6) *Elephas columbi* (?), a large piece of bone from the drift at Brainerd, Crow Wing County, Minnesota.

(7) *Elephas columbi* (?), a part of a femur labeled an "elephant leg bone from the drift at the site of the M. & St. L. roundhouse, Cedar Lake," Minneapolis, Hennepin County, Minnesota.

(8) *Elephas columbi*, a tooth from Hastings, Dakota County, Minnesota.

(9) *Elephas columbi*, a tooth dredged from the Mississippi River at St. Paul, Minnesota.

(10) *Elephas columbi*, portions of a skeleton from post-glacial lake beds, four miles west of Frost, Faribault County, Minnesota.

(11) *Elephas columbi*, about a fourth of the skeleton, including the upper jaw and teeth, from post-glacial lake beds sixteen miles northeast of Albert Lea, Freeborn County, Minnesota.

(12) *Elephas columbi* (?), base of the skull, showing the occipital condyles, from the drift thirty feet below the surface at Russell, Lyon County, Minnesota.

(13) *Elephas columbi* (?), a tusk, originally four feet long, from the glacial gravels thirty feet below the surface at Farmington, Dakota County, Minnesota.

(14) *Mastodon americanus* (?), a tusk from the superficial deposits (glacial?) at Stillwater, Washington County, Minnesota.

The remains of Pleistocene mammals and of those that immediately succeeded that period are frequently found in the gravels, peat bogs and old lake beds of Minnesota. Among these the Columbian elephant is probably the most common, but no very great attempt has been made to collect those picked up from time to time nor to make a record of the finds as they are reported. But from the number that come in to the university by this casual manner it would seem they must be abundant.

CLINTON R. STAUFFER
UNIVERSITY OF MINNESOTA

IS THERE AN ENTOMOGENOUS FUNGUS ATTACKING THE CITRUS RUST MITE IN FLORIDA?

IT has been observed annually since 1912 that the citrus rust mite (*Phyllocoptus oleivorus* Ashm.) reaches the point of maximum infestation some time just after the beginning of the rainy season. This is usually the last of June or very early in July. At this time they are usually present in countless numbers. In some instances a single grapefruit may be infested with more than a half million mites. Shortly after the point of maximum infestation is reached the mites disappear as if by magic, so that by the middle or end of September it is nearly impossible to find a single mite present. In some cases more than an hour of diligent search is required to find a single specimen.

There is considerable evidence to show that this disappearance of the citrus rust mite is due to a fungus disease. In many instances the mites congregate on a small area of the fruit which is in the most

direct sunlight. When so herded together, the area occupied by them becomes yellow and it is impossible to see the rind of the fruit at all. The mites in this mass seem to be stuck to each other like numerous angle worms. They are a writhing, wriggling mass and crawl around without any apparent object or direction. Shortly after this congregating the dead bodies of the mites are observed. They occupy the same spot in the direct sunlight as they did before death. The dead bodies take on a more brownish color than when alive. This congregating habit is contrary to the normal habits of the species. Normally this species seek semi-sunshine or partial shadows and are not found in great abundance on the part of the fruit in direct sunlight. This abnormal habit of congregating has been observed many times since 1920.

It has also been observed that most of the adult mites change color from a lemon yellow to a darker or orange yellow. They also become somewhat sluggish in their movements.

An examination of the dead mites usually shows that certain fungal filaments protrude from their bodies. In most instances, also, there are fungus bodies on the inside of the dead mites. In fact, these bodies have been observed in mites which were still alive but which had changed color and become sluggish in their movements. The presence of these fungus bodies in the living mites indicate that the time is approaching when the species will disappear.

There is an enormous amount of data on file in the Bureau of Entomology which proves beyond the possibility of a doubt that the rust mites always become much more abundant following the use of copper sprays or compounds than they do on unsprayed trees and fruit. They are also abundant a considerable length of time after the beginning of the rainy season when scarcely any mites are present on trees not sprayed with copper sprays. The use of such fungicides evidently eliminates the fungus disease which in all probability under normal conditions would have attacked the rust mites. It seems, according to the circumstantial evidence already obtained, that it is reasonably certain that an entomogenous fungus attacks rust mites in Florida. In all probability this same disease attacks the species wherever the climatic conditions permit.

A. T. SPEARE,
W. W. YOTHERS
BUREAU OF ENTOMOLOGY,
U. S. DEPARTMENT OF AGRICULTURE

PREVENTION OF WEAK LEGS IN EXPERIMENTAL CHICKENS

A DISCUSSION by J. S. Hughes appearing in SCIENCE, February 29, 1924, stated that young chicks often could not be successfully raised in confinement for experimental purposes. He attributes failure to the fact that rickets or "weak legs" develop, due, he thinks, to the absence of direct sunlight. His remedy is to expose the chickens for a few hours each day to sunlight which is not filtered through glass, or to include in their diet cod liver oil, which he has found will prevent the disease.

At present, April 1, 1924, we have in the laboratory 21 chickens which were hatched November 12, 1923. When three days old they were placed in small cages which had been previously sterilized. From that time on they were given no food, grit, water or litter that had not been sterilized. The room in which they were kept was not particularly sunny, and never at any time were they exposed to sunlight that was not filtered through glass windows. Their food consisted chiefly of buttermilk mash, which was always available. When about eight weeks old small amounts of bone meal were mixed with the mash, and raw potatoes were fed to them about twice a week from that time on, the outside of the potatoes being sterilized by immersing them in boiling water. A few carrots were similarly treated, but other than that no vegetables were given. A mixture of fine grains and an abundance of crushed oyster shell and grit composed the remainder of the diet, with the exception of a few dozen hard-boiled eggs, which were fed during the first three months.

None of this lot of chickens has shown any tendency towards the development of "weak legs," although at no time exposed to unfiltered sunlight or furnished cod liver oil. Only a small amount of hard-boiled egg was fed at any time, but the normal development of these chickens may have been to a large extent due to this ingredient in their diet.

JANE COLLIER
DEPARTMENT OF COMPARATIVE PATHOLOGY,
HARVARD MEDICAL SCHOOL, BOSTON, MASS.

PERMANENT PHOTOGRAPHS

PROFESSOR PEIRCE's letter in SCIENCE for April 4 (LIX, No. 1527, pp. 318–319) and Dr. Howard's letter for May 9 (LIX, No. 1532, pp. 422–423) have recalled to the writer's mind an experience, the results of which are of interest to any one making a collection of photographs in which the first requirement is permanency of the photographs collected.

In August, 1915, the writer moved from Palo Alto, Calif., to Ithaca, New York. Boxes of freight containing his books, instruments and miscellaneous collection of photographs were routed east by way of Galveston and New York City. At Galveston they were caught on the wharf by the hurricane of August

19 and were soaked in seawater. They were then carefully forwarded to Ithaca where they were stored in a freight shed until November when the writer arrived in Ithaca. On opening, they were found to have dried out, but all metal objects were crusted with rust, books were black with mould and the photographs were reduced to mouldy cards, on which the emulsion surface was changed to a chalky deposit that showed no traces of the former image; *except* a few *platinotypes,* which survived the whole exposure. These were soaked off of their card backs and, except for some slight moulding, were as perfect as when they were first made. It was a revelation as to what kind of a photograph was really permanent.

The platinotype is a gray or black and white print that was much in vogue thirty years ago. A metallic film is deposited directly on the paper of the print so there is nothing organic to change except the paper itself. The print is as permanent as the paper. It is more difficult to print and is more expensive than the present emulsion prints, but for a collection of portraits such as Professor Peirce and Dr. Howard describe, it makes prints every bit as permanent as engravings and etchings.

CLARENCE H. KENNEDY
DEPT. OF ZOOLOGY AND ENTOMOLOGY,
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SCIENTIFIC BOOKS

Investigations on the Red River made in connection with the Oklahoma-Texas Boundary Suit. By E. H. SELLARDS, B. C. THARP and R. T. HILL. 8vo., 174 pp., 9 plates, 7 maps in color. University of Texas Bulletin No. 2327.· 1923.

THE state of Texas has signalized its victory in the famous Red River boundary dispute by issuing a bulletin of the scientific investigations on which the decision was won. In 1890 the Supreme Court of the United States interpreted the treaty of 1819 between the United States and Spain in such a manner as to fix the south bank of the river as the boundary line. The discovery of oil at Burkburnett in 1918 and in the river valley in 1919 rendered it necessary to determine what constituted the south bank, where the definite boundary should be drawn and whether this line had been affected by changes in the course of the river during the lapse of a century. Suit was accordingly brought by the state of Oklahoma, with the United States as intervener, against the state of Texas for the purpose of locating the exact boundary and settling the title to the valuable oil lands in the "Big Bend" of the river. The main contention of the plaintiff was to the effect that at the time of the treaty with Spain the river in this region flowed at or near the foot of the Texas bluff. On the other hand, the defendant maintained that neither the channel nor the bordering sand stretch lay adjacent to this bluff in the Big Bend area during the past hundred years. As a corollary, Oklahoma contended that the valley had been developed by a process described as "island building" and that all trees more than a hundred years old had originated on such islands, while Texas maintained that the development had followed the normal process of erosion and accretion and that the trees had begun growth on the proper floor of the valley.

The main body of the bulletin is divided into three sections, as follows: (1) geologic and soil studies on the alluvial lands of the Red River Valley, by E. H. Sellards; (2) ecologic investigations, by B. C. Tharp; (3) physiographic investigations, by R. T. Hill. In the first section, the most interesting and important studies had to do with the age of the river valley as indicated by the series of dunes and by the growth of trees. While the latter gave the most dramatic evidence, the former constituted a distinct contribution to the physiography and soils of a river system. With regard to the sand-dunes, it was found that their formation is determined by the source of the sand rather than by the direction of the controlling winds, and that they are built on the land as a rule and not on the sand-bed of the river. Dune development in the Big Bend area has not been a haphazard matter, but the dunes fall into four definite series, representing four different periods, probably corresponding to as many successive dry phases of the climatic cycle. The first or oldest series lies close to the Texas bluff, and the last or newest one parallels the sand-plain of the stream. The relative age of the several series is indicated by their position, vegetation and soil, all of which were found to be in entire agreement. The most novel evidence was obtained from the mechanical analysis of the top soil of the successive series, which gave 1 per cent. of finest material for the new dunes of series four, 5 per cent. for series three, 16 per cent. for two and 20 per cent. for series one, the oldest. This increased fineness of the top soil with age is explained by the progressive disintegration of soil particles, the addition of organic matter, and the accumulation of dust particles, and is in complete accord with the successional advance of the plant communities.

The age of the valley was further indicated by the thickness of the soils in relation to the age of trees growing in them and especially by the ring-counts of trees found on the alluvial fans. By determining the depth of soil above the river sand and the amount of fill above the main roots of the trees, it was possible to use the ring-count to approximate a period of four or five hundred years since the tributary began to accumulate a fan on the valley land. The study of the

habits of the river in building its valley led to the conclusion that this was regularly in accordance with the process of accretion by which each new area more or less completely enclosed the older, and that the life-cycle of each individual valley could not be completed in the brief span of a single century.

The ecologic investigation of the Big Bend area was carried out principally by means of transects to determine the successional relations of the various communities from the Texas to the Oklahoma bluff, and by means of ring-counts of the trees scattered over the floor of the valley. The species were listed along each transect in accordance with their importance and then grouped in tables to facilitate comparison between the various localities. This not only rendered possible a complete outline of the development of the climax association in the region, but also afforded a definite comparative basis for the age of different portions of the valley in terms of the climax on the bluffs at either side. Of striking value is the analysis of the cottonwood stage in the succession and its indications for the age of the area occupied. The results of the serial study are in entire accord with those obtained by the reviewer for the dune areas of the river valleys of Oklahoma and of other rivers in the semi-arid and arid regions.

Ring-counts were made of 31 trees of various species which grew scattered over the valley floor. These were chiefly elm and cottonwood, with occasional pecan, ash, hackberry, etc. A third of the individuals gave ages ranging from 100 to 175 years and thus established beyond question the minimum age of the greater portion of the valley as considerably beyond one hundred years.

The results of the ecologic investigation are summarized as follows: The climax stage of the vegetation for the Big Bend region is the short-grass plains modification of the mixed prairie association.

The treeless portions of the valley have virtually reached the climax stage, as is indicated by comparing their vegetation with that of the bluffs on both sides of the river.

While the length of time required for a given area to pass from the initial stage to the climax can not be definitely stated in years, there is much evidence to support the view that it must take at least several hundred years, for example:

(1) Upon a tract on the Oklahoma side above Granfield Bridge, which in its oldest portion must have exceeded 100 years, only ten climax dominants had become established.

(2) At the southernmost limit of the cottonwood savannah, estimated to be more than 150 years of age, only five of a total of 18 climax dominants noted for the valley in this area had appeared.

(3) Using the cottonwood savannah as a basis for judgment, it seems entirely conservative to estimate 150 years as the minimum time required for the cottonwood stage to pass from initiation to extinction.

(4) There is no evidence of closer correlation between the age of the oldest trees in the valley and the maximum age of the soils that support them than there is between the ages of the trees and soils of the uplands along the river.

The conclusion from the studies of the life-history of the Red River is that the alleged islands, as the windrow-like fringing dunes were considered, are not islands at all but land-made features built on the valley-floor at times when a wide strip of flood-plain existed between channel and bench. Therefore, they have never been islands, and there is no ground for the assumption that the valley has been formed by a process of island building.

The maps that accompany the report are of a uniform excellence, and leave nothing to be desired in the matter of scale, execution or detail. From the standpoint of the ecologist they may be regarded as model base-maps for accurate quantitative work in succession.

The ability of the court to weigh scientific evidence accurately and to discriminate between presumption and proof is clearly shown by the following excerpts from the text of the decision:

The valley land has always been dealt with as upland. . . . Through the long period covered by this course of action there never was any suggestion that this valley land was part of the river bed, nor that the shifting elevations of sand within the sand bed were the river's banks, nor that the land on the south side belonged to the United States. Not until some land on the south side and part of the river bed were discovered to be valuable for oil was this unbroken course of action and opinion drawn in question. However much the oil discovery may affect values, it has no bearing on the questions of boundary and title.

The boundary as it was in 1821, when the treaty became effective, is the boundary of to-day, subject to the right application of the doctrines of erosion and accretion and of avulsion to any intervening changes.

There are no surveys or records depicting the situation in 1821; nor are there any human witnesses who knew this part of the river then. But there are inanimate witnesses, such as old trees, which tell a good deal. At that place the river makes a pronounced but gradual bend to the north and back to the south. The area in question is on the inner side of the bend. It is larger now than 60 years ago, but how much is uncertain. The enlargement is the result of intervening accretions. The habit of the river is to erode the outer bank of a bend and to accrete to the opposite bank. . . . On the outer part are physical evidences of the formation being comparatively recent. On the inner part are like evidences of the formation being old, among them being the presence of living trees more than a century old. One of the trees,

a pecan, attained an age of 170 years. . . . To overcome the inference arising from the presence of the old trees, which were well scattered, testimony was presented to show that in 1821 these trees were all on islands, which afterwards were consolidated amongst themselves and with the lands on the south side. We think this testimony is essentially speculative and not a proper basis for judgment. In this area, as elsewhere in the valley, a succession of depressions is found at the foot of the bluffs and some testimony was produced to show that in 1821 the river, or a part of it, flowed there. It may be that the river was there long ago, but the testimony that it was there in 1821 is far from convincing. Our conclusion is that the claim that the river, or any part of it, ran south of this area in 1821 is not sustained. So the boundary follows the cut bank around the northerly limit of the area.

The perusal of the thousands of pages of testimony leads to the conviction that scientific experts should be appointed by the court and not employed by the litigants. This fact has already been emphasized by one of the scientists concerned (*Geog. Rev.*, 13: 188), who points out that the present practice fosters bias and discounts the spirit of scientific research (*cf.* also SCIENCE, 45: 147, 292). Indeed, it would seem that such cases as the present should not be matters of court procedure at all, but should be left to the decision of a disinterested scientific commission.

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SPECIAL ARTICLES

THE CHROMOSOME COMPLEXES IN THE SOMATIC CELLS OF MALE AND FEMALE OF THE DOMESTIC CHICKEN

IN publishing the rough notes and drawings of the late Miss Stevens on the spermatogenesis of the domestic fowl, Miss Alice Boring points to the insufficiency of our knowledge of the chromosome complex of birds. This state of affairs, together with the intensive work on the genetics of fowl which has been going at the Anikovo Genetical Station of the Moscow Institute of Experimental Biology, induced Professor N. K. Koltzoff to offer this theme to me for further investigation. This work began in the summer of 1922 and was conducted on embryological material, as well as on the testicles of young and adult cocks. Last summer I also investigated some other birds of the family *Passeres.*

Some fundamental results of my investigation had already been reported at the conference of the Anikovo station last June and published as a footnote in the Russian translation of T. H. Morgan's "Physical Basis of Heredity," and the drawings of the chromosome complex of the fowl were amongst the other exhibits of the Anikovo station at the Russian Agricultural Exhibition (inaugurated on August 15), when Number 1491 of SCIENCE (of July 27, 1923) with the stimulating article of Miss Boring came to my hands. The following discoveries confirm some results of Miss Stevens and contain also some quite new facts.

The fundamental results of my investigation can be briefly summed up in the following points:

(1) The somatic complex of chromosomes in fowl of the same sex is characterized by a complete uniformity in all tissues of the embryo.

(2) The chromosome complex consists of chromosomes of very different lengths, whereas the thickness of all chromosomes when properly fixed and colored is quite the same and is nearly equal to 0.5 μ. The shortest are from one fifth to one sixth the length of the longest, which may attain nearly 3 μ (see the chromosomes X, x, B and b in the given drawings). The ordinary form of the chromosomes in the somatic cells is rod-shaped. One may see that any windings, which are to be observed in the longest chromosomes in the equatorial plates, should disappear in the metakinesis stage, when all chromosomes become straight.

(3) In the equatorial plate, at first, when the chromosomes are lying very near one another, they have a very regular and constant position. Their disposition is very characteristic, the longer ones lying outside and the smaller ones inside, as has been shown also by Miss Stevens in her drawings (Figs. 1 and 2). The elements of the outer circle lie in a more or less radial arrangement. Moreover, a very essential circumstance appears here, namely, that the long chromosomes have a tendency to a symmetrical disposition, every long chromosome on the right having its homologue on the left; this is to be particularly noticed in the early equatorial plates and likewise in the daughter plates in the males. This makes the pairs easier to find, especially in the case of the long chromosomes of the outer circle. In figures 1 and 2 the paired chromosomes of the right are designated by letters, A, B, C, and those of the left by small ones, a, b, c. A detailed study of the chromosome complexes of the male and the female lead me to designate these pairs with signs different from those given in Miss Boring's drawings.

(4) The constancy and symmetry of position of the chromosomes may also be observed in some degree in the pachytene spireme, which after the dissolution of the nuclear membrane spreads very regularly like a parachute, whose meridional ribs are lying like the long chromosomes of the outer circle.

(5) In consequence of the small size and comparatively large number of chromosomes in the fowl it is difficult to count them precisely. I have tried, however, to count the chromosomes in many mother and

daughter plates in different tissues of 15–17 day old embryos, whose sex had been positively determined by the examination of their gonads, and in view of this I consider the following results as quite established:

(A) In the homozygous male sex of fowl the chromosomes in the somatic cells appear to be paired (in respect to type) and their number is equal to 32 (see my figure I and Miss Boring's figure 2). The same complex with all its peculiarities is to be found also in the primitive generative cells and in the spermatogonia.

(B) In the heterozygous female sex the somatic complex of chromosomes differs from that of the male sex in that here one of the longest chromosomes (an X-chromosome) is not present; in its place there is usually to be observed a small Y-chromosome which, however, is not always distinct in the equatorial plate.

(C) The male complex consists therefore of 30 autosomes + 2 X-chromosomes, and the female complex of 30 autosomes + X + Y-chromosomes.

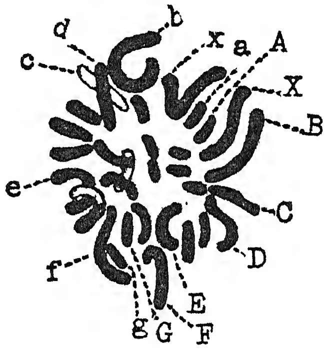

Fig. 1. Male

A comparative study of male and female complexes shows that the X-chromosome is among the longest of the chromosomes and lies in the outer circle of the equatorial plate near chromosome B (or the corresponding chromosome b of the left side), at the upper end of the axis that divides the equatorial plate into right ("paternal") and left ("maternal") sides. In the male the behavior of both X-chromosomes during all mitotic processes is not influenced by the behavior of the neighboring autosomes and they remain side by side between the chromosomes B and b. In the female, however, the unique X-chromosome always lies at first between the autosomes B and b in the early equatorial plate, as in the male, but later on it changes its place, evidently under the influence of the reciprocal attractions of both corresponding chromosomes B and b, and it may come to occupy any position, as in figure 2. Sometimes it lies quite isolated outside the outer chromosome circle. This often makes the configuration of the female equatorial plate less regular than that of the male one.

(6) The chromosome complexes of the different Passerine birds studied appear to be very similar to that of fowl in their chief characters; this induces us to believe that this complex is peculiar to most birds.

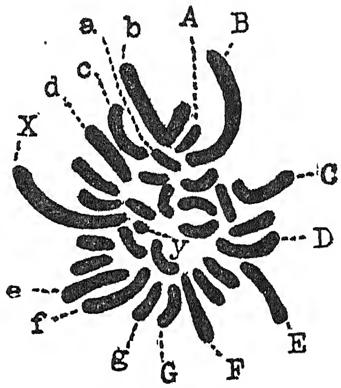

Fig. 2. Female.

In drawing the figures given a camera lucida was used, together with an apochr. oil immersion 2 mm. (Zeiss) and No. 18 compound ocular.

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NOTE ON THE AVERAGE NUMBERS OF BROTHERS AND OF SISTERS OF THE BOYS IN FAMILIES OF N CHILDREN

The question to be answered in this note was brought to my attention by Dr. J. McKeen Cattell. That the question presents a point of interest may be accepted from the fact that a scientist with the keen statistical intuition of Francis Galton seems to have drawn an incorrect inference where this question was involved (see Cattell and Brimhall, "American Men of Science," 1921, p. 804). Galton in his "Hereditary Genius" says: "I also have found the (adult) families to consist on the average of not less than 2½ sons and 2½ daughters each. Consequently, each judge has on the average 1½ brothers and 2½ sisters." As stated in "American Men of Science," "It seems to most people obvious that if there are equal numbers of boys and girls, a boy must on the average have one more sister than brother." Thus, the statement quoted from Galton would be regarded as obvious by most people. Dr. Cattell pointed out the error in this view, and clearly demonstrated for families of two children the fact that the boys have on the average as many brothers as sisters. It is the object of this note to demonstrate the fact stated by Cattell for families of any size, say families of n children each, in which boys and girls occur on the average in equal numbers. That is, assuming that ½ is the probability that a child taken at random

(1)	(2)	(3)	(4)	(5)
Number of Brothers	Number of Sisters	Frequency	(1) × (3)	(2) × (3)
0	$n-1$	kn	0	$kn(n-1)$
1	$n-2$	$kn(n-1)$	$kn(n-1)$	$kn(n-1)(n-2)$
2	$n-3$	$\frac{kn(n-1)(n-2)}{2!}$	$kn(n-1)(n-2)$	$\frac{kn(n-1)(n-2)(n-3)}{2!}$
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
$n-3$	2	$\frac{kn(n-1)(n-2)}{2!}$	$\frac{kn(n-1)(n-2)(n-3)}{2!}$	$kn(n-1)(n-2)$
$n-2$	1	$kn(n-1)$	$kn(n-1)(n-2)$	$kn(n-1)$
$n-1$	0	kn	$kn(n-1)$	0
	Totals	$kn\ 2^{n-1}$	$kn(n-1)2^{n-2}$	$kn(n-1)2^{n-2}$

from the group is a boy, it will be proved that $(n-1)/2$ is the most probable value of the arithmetic mean of the number of a boy's brothers, and likewise of the number of his sisters. Consider a large number N of families and for convenience assume that N is a certain number of time 2^n, say $N = k2^n$. Then the *a priori* most probable numbers of families with 0, 1, 2, :::, n boys is given, respectively, by the terms k, kn, $kn(n-1)/2!$, : : :, $kn(n-1)/2!$, kn, k in the binomial expansion of $k(1+1)^n$.

First note that k families out of $k2^n$ have no boy; second, that kn families have only one boy each and therefore they have kn cases of no brothers and $n-1$ sisters; third, that $kn(n-1)/2!$ families have two boys each, and hence they have $kn(n-1)$ cases of one brother and $n-2$ sisters; fourth, that $kn(n-1)(n-2)/3!$ families have three boys each, and hence they have $kn(n-1)(n-2)/2!$ cases of two brothers and $n-3$ sisters; and so on. The manner of the distribution seems sufficiently clear without further illustration.

Then we set up the ordinary form for finding the arithmetic means of the number of brothers and of the number of sisters in the accompanying table.

The totals of columns (4) and (5) are equal, and each divided by the total of column (3) gives $(n-1)/2$. Hence $(n-1)/2$ is the arithmetic mean of the number of brothers, and of the number of sisters.

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(Continued)

The electrochemistry of free radicals: J. B. CONANT, L. F. SMALL and A. W. SLOAN. The halochromic salts of triaryl and diaryl carbinols are rapidly reduced in acetic acid solution by vanadous salts to the corresponding ethanes which can be obtained in good yields. If these ethanes are dissociated with the formation of free radicals, a significant potential of the process can be measured by the titration method, or by mixing the free radical and the halochromic salt. Similar results can be obtained with certain more stable xanthylium salts even in an aqueous and alcoholic solution. These potentials are the equivalent of the single electrode potentials of the metals, and vary according to the nature of the free radical. The reduction of halochromic salts to free radicals is being used to prepare free radicals hitherto inaccessible; benzylxanthyl has been thus obtained.

Condensation of phthalic anhydride with aryl hydrocarbons: O. R. QUAYLE and E. E. REID. The condensation of phthalic anhydride with aromatic hydrocarbons containing fluorine has been studied, and a number of fluor-benzoyl-benzoic acids prepared. These have been condensed to form the corresponding substituted anthraquinones.

Condensation of cyclohexanone with aldehydes: C. E. GARLAND and E. E. REID. Cyclohexanone has been condensed with p-toluic aldehyde, p-brombenzaldehyde, furfural and anisic aldehyde. The complex ketones have been hydrogenated and also subjected to the Grignard reaction. The tertiary alcohols so formed have been dehydrated and the unsaturated hydrocarbons hydrogenated.

Reactions of unsaturated 1, 4 diketones: J. B. CONANT, R. E. LUTZ and L. F. LEA. Dibenzoyl ethylene and its derivatives combine with ammonia, aniline, malonic ester (in the presence of sodium alcoholate), hydrogen chloride, acetyl chloride and acetic anhydride yielding substituted 1, 4 diketones or, in certain cases, substituted furans; from the former, pyrrols can be prepared. Dibenzoyl ethylene dibromide easily loses two molecules of hydrogen bromide when treated with alkaline reagents; the resulting dibenzoyl acetylene combines at once with water, alcohol or phenol according to the nature of the reagent

employed. The product in the first instance is a strongly enolic 1, 2, 4 triketone.

Benzylpseudothiourea salts of naphthalene sulfonic acids: R. F. CHAMBERS and P. C. SCHERER. The method of preparation of the benzylpseudothiourea salts of a series of the more common mono and disulfonic acids of naphthalene is given, and these salts have their properties described. The melting points, solubility curves in n/5 HCl, solubilities in organic solvents, crystal forms and water of crystallization have been determined and are described. On account of their extreme ease of preparation and definite melting points, these compounds are suggested as a means of identification of the naphthalene sulfonic acids.

Reduction potentials of polycyclic anthraquinones and the structure of anthracene: L. F. FIESER. The reduction potential of ang. benzanthraquinone ($\pi_0 = 0.226$) in alcoholic solution is considerably higher than that of anthraquinone ($\pi_0 = 0.155$) while lin. benzanthraquinone can not be reduced by zinc dust and boiling alkali, and attempted measurements indicate a reduction of potential of less than 0.100v. This difference in the effect of the phenylene group on the potential of anthraquinone, exhibited also in the dibenzanthraquinone series, is interpreted on the basis of the ortho-quinonoid structure of anthracene and the comparison of the properties of the quinonoid systems of the anthrahydroquinones in question with the properties of true quinones.

Researches on the selenium compounds—III. The synthesis of benzo-bis-selenazoles and thiazylbenzoselenazoles, new heterocyclic systems. The preparation of a selenium derivative of cinchophen type: M. T. BOGERT and H. H. HOPKINS. Benzalamino benzoselenazoles when fused with sulfur or selenium yield the following heterocycles:

$$R \cdot C \begin{array}{c} N \\ \\ S \end{array} C_6H_2 \begin{array}{c} Se \\ \\ N \end{array} C \cdot R \quad \text{and} \quad R \cdot C \begin{array}{c} N \\ \\ Se \end{array} C_6H_2 \begin{array}{c} Se \\ \\ N \end{array} C \cdot R$$

The thiazylselenazole adds bromine or acetyl chloride, and is easily nitrated. The bis-selenazole exhibits properties similar to those of the simple benzoselenazoles. Such bis-selenazoles also result from the fusion of the dibenzal derivatives of phenylene diamines with selenium. The 6-furalamino-2-phenyl-benzoselenazole is decomposed by fusion with either sulfur or selenium. From 6-amino-2-phenyl-benzoselenazole, the corresponding 6-cyano and 6-COOH derivatives were prepared, the latter being a selenazole analog of Cinchophen (Atophan), resembling the thiazole compound described by Bogert and Abrahamson (*J. A. C. S.*, 44, 826 (1922)).

Researches on quinazolines—XXXV. Stereoisomeric styryl derivatives of some 4-quinazolone alkyl iodides, and their bearing upon the problem of photosensitizing dyes: H. CLARK and M. T. BOGERT. (1) Great difficulty was experienced in the preparation of alkyl iodides of 2-methyl-quinazolines, although the corresponding derivatives of 2-methyl-4-quinazolones were obtained easily. (2) The non-reactivity of 2, 4-dimethyl-quinazoline with aromatic aldehydes is at variance with certain recent hypotheses concerning reactive methyl groups of nitrogen heterocycles. (3) Attempted "cyanine condensations" with 2-methyl-4-quinazolone alkyl iodides resulted negatively. (4) 2-Methyl-4-quinazolone alkyl iodides were condensed with p-dimethylamino benzaldehyde in the presence of acetic anhydride or piperidine, yielding the corresponding styryl derivatives. (5) Cis and trans forms of these styryl derivatives were separated by fractional crystallization from methyl alcohol. The two forms differed widely in appearance and in melting point. (6) The lower melting (labile) isomer was convertible into the higher melting (stable) one, but the reverse change could not be effected. (7) The products were devoid of photosensitizing properties and valueless as dyes. (8) The two stereoisomers gave identical mono-bromo dibromides when treated with bromine in chloroform solution. (9) In the course of the work, the following new compounds were prepared: cis and trans forms of the methyl iodides of 2-p-dimethylaminostyryl-4-quinazolone, of 3-methyl-4-quinazolone, of 3-ethyl-4-quinazolone, also of the ethyl iodides of 3-methyl-4-quinazolone, and their bromination products.

The preparation of oxindole derivatives from isatin: A. J. HILL and A. S. SCHULTZ. Isatin, as well as its mono and dibrom derivatives, will condense with the activated methylene groups of diketopiperazine and hydantoin. The reduction and subsequent hydrolysis of these new condensation products should theoretically lead to the formation of oxindole amino-acetic acid (A), or oxindole acetic acid (B) and the corresponding halogen derivatives.

$$\begin{array}{ll} \text{(A)} & C_6H_4(NH \cdot CO : CH) - CH \cdot NH_2 \cdot COOH \\ \text{(B)} & C_6H_4(NH \cdot CO \cdot CH) - CH_2 \cdot COOH \\ \text{(C)} & C_6H_4(NH \cdot CO \cdot C) : CH \cdot COOH \end{array}$$

From the unsubstituted isatin condensation products, the writers have obtained (B) and its unsaturated homolog (C), depending upon the reagents employed. The amino acid has not been isolated, since deaminization occurs, even when mild hydrolytic agents are employed. Oxindole acetic acid may be obtained from (C) by reduction. The former is readily brominated in sulfuric acid solution. This method for the synthesis of oxindole derivatives is being extended to include not only the brominated, but also the iodated types which are somewhat related to thyroxin in their molecular configuration.

The substituted thioureas—V. The synthesis of thiazolidine derivatives: F. B. DAINS, R. Q. BREWSTER, I. L. MALM and A. W. MILLER. (a) The synthesis of alpha-aryl (or alkyl)-alpha-ethanol-beta-alkyl (or aryl) thioureas. $RN(CH_2CH_2OH)CSNHR'$ from the substituted aminoethanols and mustard oils. (b) The conversion of these thioureas into thiazols of known structure. (c) The formation of thiozolines from ethylene dibromide and thioureas of the type RNHCSNHR′, where R and R′ are different groups. (d) Some di-thio-ethylene ethers from aryl-alkyl thioureas.

The oxidation of carbohydrates with air: H. A. SPOEHR. Thus far it has been possible to oxidize the hexoses with air only in alkaline solution. While disodium phosphate catalyzes the oxidation of glucose with H_2O_2, it does not affect the oxidation with air. Glucose and other hexoses are oxidized with the formation of CO_2 by air in solutions containing Na_2HPO_4 and methylene blue. This reaction is greatly accelerated by small amounts of Fe salts. Sodium ferro pyrophosphate is a more active catalyst for the oxidation of carbohydrates than methylene blue. Not only are the hexose sugars thus oxidized, but sucrose, trehalose and other compounds which do not reduce Fehling's solution are easily oxidized. From a consideration of the rates of oxidation of different hexoses, it appears that glucose is first converted into levulose by the Na_2HPO_4.

The lactones of l-mannonic and d-mannonic acid: F. W. UPSON and L. SANDS. Nef and Hadenburg have shown that there are two d-mannonic acid lactones, one of specific rotation plus 112° and changing rapidly in solution to a rotation of about plus 28°. Nef called this provisionally the beta-lactone. The gamma-lactone, rotation plus 53°, changes very little in solution. We have the analogous lactones of l-mannonic acid. Further, we have shown that Nef's beta-lactone possesses in all probability a pentylene-oxide structure and that, further, the sugar, d-mannose, possesses also a pentylene oxide ring structure.

Separation of alpha and beta amylose. Properties of alpha and beta amylose: T. C. TAYLOR and H. A. IDDLES. A study has been made of the possibilities of separating the alpha and beta components of corn starch through the agency of the electric current. Alpha amylose wanders to the positive electrode, while the beta amylose remains dispersed. The solution of the beta amylose can be decanted from residue of the alpha which collects in compact mass. Proper treatment of these two components gives the respective amyloses. The alpha contains 1.25 per cent. combined fatty acids, while the beta is apparently pure carbohydrate. The latter amylose goes into "solution" in water heating, to the extent of at least 6 per cent. It gives a pure blue color with iodine-iodide solutions and is very quickly hydrolyzed by malt diastase. Detailed investigation of the properties of these two components are under way.

Identification of fatty acids liberated by hydrolysis of corn starch: T. C. TAYLOR and L. LEHRMAN. Oleic acid and linoleic acid have been identified by their oxidation products and bromides as being the unsaturated fatty acids which together with palmitic acid are liberated by the acid hydrolysis of corn starch.

The catalyzed oxidation of galactose: E. C. WHITTIER. This oxidation by nitric acid is of interest in connection with the production of mucic acid from milk sugar or galactose. Vanadium pentoxide was the only substance tested that accelerated the oxidation of galactose by nitric acid. Thirty-five to forty per cent. is the optimum range of concentration of nitric acid for mucic acid production at 85°. Both higher concentration of oxidizing agent and addition of vanadium pentoxide increase the production of oxalic acid and carbonic acids at the expense of mucic acid.

The extraction of maltase from yeast: V. K. KRIEBLE, E. L. SKAU and E. W. LOVERING. Previous investigations on maltose from yeast have shown that an acid is formed in the extraction, but have disagreed as to the best method of extraction, and the treatment of yeast previous to extraction. Our experiments have shown that maltase can be extracted either from fresh or dry yeast, a more active extract being obtained from dry yeast, and that the strength of the extract depends on the condition of the yeast, the length and temperature of extraction, and the P_h of the extractive medium. Maltase even at 15° is destroyed gradually in the extractive medium so that, as the extraction progresses, the activity of the extract rises to a minimum and then decreases—the rate of decrease being influenced by temperature and the medium of extraction.

Preparation of tartaric acid from maleic and fumaric acids (By title): N. MILAS and E. M. TERRY. The K. A. Hofmann method of oxidating maleic and fumaric acids to meso tartaric and racemic acids, respectively, has been materially improved by a study of the variation of yield at different hydrogen ion concentrations. The catalyst, osmium tetroxide, can be removed and reused. The mechanism of the reaction will be given in brief.

A study of directing influence of substituents in the benzene ring by means of rate of bromination: J. JOHNSON, A. J. HILL and A. W. FRANCIS. Amino and phenolic compounds in aqueous solution are brominated rapidly in all available ortho and para positions. The rates are influenced greatly, however, by other substituents in the ring. The absolute velocities are far too great to be measured directly, but consistent relative rates have been estimated by means of a series of partition experiments, allowing insufficient bromine to react simultaneously with two compounds, and analyzing the products. In this way measures of the relative velocity of bromination in all positions of about 35 benzene derivatives have been ascertained. A comparison of the influence of the several groups under various conditions is thus possible.

A simple relation between composition and boiling point of organic liquids: E. Q. ADAMS. Longuinescu found an appropriate relation for normal organic liquids between the absolute boiling point, density of no. of atoms in the molecule: $T\sqrt{(D\sqrt{n})}$ — 100 approx. An even more exact expression, not involving density, has been found. If the elements be weighed according to the row in the periodic table in which they occur (system of Rydberg), *i.e.*, H is disregarded; C, N, O, F count 1; Si, P, S, Cl, 2, etc., the relation T equals to the square root of 2000n holds within one unit of "n" for most organic liquids, and for many inorganic nonelectrolytes.

The chlorination of 2-amino-p-xylene: A. S. WHEELER and M. MORSE. 2-Amino-p-xylene was converted into its acetyl derivative and chlorinated at a low temperature. Chlorine was substituted in position 5. This was proven by converting it into 2, 5-dichloroxylene and oxidizing this to 2, 5-dichloroterephthalic acid. A new series of azo dyes was prepared by diazotizing 2-amino-5-chloro-p-xylene and coupling it with the following phenols: phenol, resorcinol, thymol, alpha-naphthol, beta-naphthol, Schaeffer's acid and Cleve's acid. Other dyes are in the course of preparation.

Borneol in spruce turpentine: A. S. WHEELER and C. R. HARRIS. The dark liquid residue left after removing most of the p-cymene from spruce turpentine by steam distillation was subjected to fractional distillation in vacuo. Direct heat was applied and a pressure of 3 mm. Using 900 cc of liquid, 400 cc proved to be p-cymene, b. p. 42°. The remainder was collected in 5 or 10 cc fractions, the last fraction collected boiling above 100° or above 300° at atmospheric pressure. All fractions were liquid except one boiling at 75–80° or 205–210° at atmospheric pressure. This was white crystalline compound of terpene-like odor (melting point 205° after recrystallizing). Analysis gave the formula $C_{10}H_{18}O$ corresponding to borneol. The melting point, crystalline form and solubilities also suggested borneol. Its phenylisocyanate gave the melting point of 141°, the same as that of borneol. The specific rotation, however, was — 12° 43′. This indicated l-borneol mixed with considerable of the dl-form.

Preparation of malic acid from maleic acid (By title): E. M. TERRY and L. EICHELBERGER. A method for the quantitative estimation of malic acid in the presence of maleic acid was first developed. Then a survey was made of the effect of different salts on the rate of addition of water to the double bond of maleic acid. Many salts were found helpful. The rate of the change when mercuric acetate was catalyst was studied in detail and an efficient method established for the preparation of malic acid from maleic acid. A theory of reaction will be given.

Study of nitration of benzoic acid (By title): H. M. SEVERANCE and E. M. TERRY. A study was made of the products of nitration of benzoic acid when the process was carried out first, with nitric acid with varying water content, and second, with pure nitric acid in acetic acid solution. For this purpose a new method was developed for analyzing mixtures of ortho and meta nitro benzoic acid in the presence of benzoic acid. This method is briefly outlined together with the results of the study.

Bromination of sodium benzoate (By title): E. M. TERRY and L. EICHELBERGER. Sodium benzoate was brominated by a new process. For the purpose of establishing the identity of the isomeric acids formed, a special method of analysis was developed. Finally good working conditions were found for the preparation of isomeric monobrombenzoic acids. It may be shown that the methods of analysis and preparation have a variety of possible applications. The mechanism of the reaction together with an outline of the above processes could be given.

Catalytic transmulation of maleic acid to fumaric acid (By title): L. EICHELBERGER and E. M. TERRY. A new theory of the mechanism of the catalytic transmutation of maleic to fumaric acids is given. It is shown to correlate the widely diversified conditions under which the process may be carried out. New experimental work is given in support of the theory.

Halogenation of maleic acid and of fumaric acid (Lantern): E. M. TERRY and L. EICHELBERGER. A new method of bromination and of chlorination of the neutral salts of mono-carboxylic acids will be presented. With the help of this method in large measure we may bring about either cis or trans addition of halogen at the double bond of the acid as we desire. A theory of the mechanism of the processes involved has been developed. This theory may be shown to apply to the Walden Inversion as well as the above-mentioned processes.

Condensation of carbon tetrachloride with phenol (By title): M. GOMBERG and H. R. SNOW. We find that, contrary to Heumann's claim (D. R. P. 68,976), the condensation of carbon tetrachloride and phenol takes place at ordinary pressures, and a good yield of aurin is obtained. In addition to aurin, several other products are produced. All these have been identified. Procedures have been worked out whereby either diphenyl carbonate or di-hydroxy-benzophenone or trihydroxy carbinols may be obtained to the almost complete exclusion of the others. A convenient method has been devised for the complete separation and purification of aurin. The properties of the latter were determined and many derivatives of it obtained. It has also been established that the technical product contains only about 50 per cent. of aurin, and the nature of impurities has been determined.

Unsymmetrical aliphatic arseno compounds: C. SHATTUCK PALMER. Several members of this previously unrecorded series have been prepared by simultaneous reduction of equimolecular proportions of two different aliphatic arsonic acids with 50 per cent. hypophosphorous acid in the cold. The products can be obtained as yellow needles but have a marked tendency to become gummy. They are practically insoluble in water and most organic solvents. Those in which one of the groups attached to arsenic is substituted by carboxyl form water-soluble sodium salts. If proper conditions of reduction are not observed, a mixture of two arseno compounds is obtained instead of the unsymmetrical derivative.

The effect of temperature on the equilibrium between benzaldehyde and benzoin: ERNEST ANDERSON and LEROY G. STORY. The value of the equilibrium constant between benzaldehyde and benzoin has been determined experimentally at six different temperatures and the results found to agree closely in each case with the value calculated by means of the Van't Hoff equation.

J. A. NIEUWLAND,
Secretary

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A TILTED-UP, BEVELED-OFF ATOLL

WHAT WOULD A TILTED-UP, BEVELED-OFF ATOLL LOOK LIKE?

IF an atoll were tilted up by deformational forces and then beveled off to low relief by degradational processes, its understructure would be laid bare. If the atoll reef had been formed on the margin of a shallow platform cut across a stationary, worn-down, deeply weathered volcanic island by the waves of the lowered and chilled ocean in the Glacial epochs of the Glacial period, according to Daly's Glacial-control theory, the revealed understructure would consist chiefly of volcanic rocks under a small thickness of lagoon deposits. If the atoll reef had been formed on the margin of a submarine bank that had been built up to small depth by pelagic calcareous deposits over a deep, non-subsiding volcanic foundation, according to the Rein-Murray theory, the tilted and beveled understructure should give evidence of such an origin by showing chiefly deep-water calcareous deposits on a volcanic mass of submarine eruption. If the atoll reef and its enclosed lagoon deposits had been built up to great thickness on a slowly subsiding volcanic island of subaerial eruption and erosion, according to Darwin's theory, the beveled understructure would declare this origin by showing chiefly shallow-water calcareous deposits above a volcanic base.

To make the latter case specific, let it be assumed that the original foundation of the atoll was a mountainous volcanic island of oval outline, about 50 miles long. If such an island sank slowly, while a barrier reef grew up around it and calcareous lagoon deposits were laid down in the "moat" enclosed by the barrier, until the island was wholly submerged, the barrier reef would become an atoll reef, as in Fig. 1. If such an atoll were tilted up at its southwestern end, and if the uptilted area were degraded to moderate or low relief, as in Fig. 2, the understructure would be well revealed. The upper beds would consist of lagoon limestones with occasional lagoon reefs, originally encircled by the marginal atoll reef; and the volcanic foundation would be laid bare beneath the limestones, if the uplift and the following degradation were of great enough measure. If a central area of the foundation were shown, the calcareous beds would there overlie the summits of the dissected volcanic range unconformably; but if only a marginal part of the foundation were shown, calcareous beds might there alternate in approximate conformity with tuffs and agglomerates, either because these volcanic

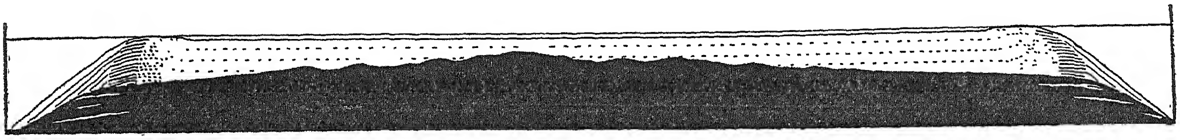

Fig. 1. Ideal section of an atoll on a volcanic foundation.

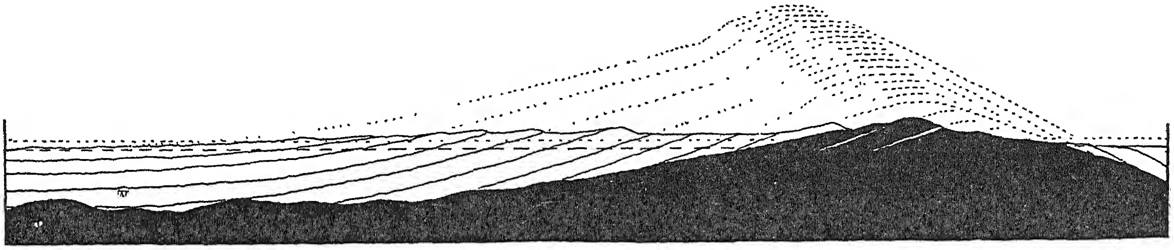

Fig. 2. Ideal section of a tilted-up and beveled-off part of an atoll, drawn on double the scale of Fig. 1.

beds were spread out beneath sea level, or because, if spread out above sea level, they were submerged by the subsidence of the island before they were much eroded during a long dormant interval when no eruptions occurred.

An Actual Island that Appears to be a Tilted-up and Beveled-off Atoll

Now there is a certain island measuring about 12 miles across, which has been examined by several geologists and which exhibits, in a series of volcanic and calcareous beds inclined to the northeast and at least 8,000 feet in total thickness, a structure very much like that just inferred for a tilted-up and beveled-off atoll built up from a subsiding foundation. Its southwestern or basal quarter is occupied by volcanic rocks, including lavas, agglomerates and ash beds, which are as a rule inclined moderately to the northeast, and which are overlaid in apparent conformity by a series of cherts, tuffs and limestones, several thousand feet in total thickness, dipping 10° or 15° northeastward and occupying the remaining three-fourths of the island. The basal district of relatively resistant volcanic rocks, stripped of its former calcareous cover, is worn down to submountainous relief; the highest summit is near the southwestern coast; it is largely composed of deep-lying lavas and has an altitude of 1,330 feet. The overlying volcanic beds more to the northeast, composed largely of agglomerates and tuffs, are etched out in a series of discontinuous cuestas, trending northwest-southeast, with strong slopes on their outcrop side and gentler slopes on their dip side.

The larger district of calcareous and other strata is reduced to low relief, except that its cherts and its more resistant limestones, both occurring in discontinuous beds of lens-like form, surmount the worn-down lowlands of weaker tuffs and marls in discontinuous cuestas, again with their scarps to the southwest and their dip slopes to the northeast. One of the cuestas, formed on a low-lying chert bed, rises with a length of two or three miles near the submountainous volcanic district, from which it is separated by a well-defined subsequent valley, evidently excavated along a series of weak strata, presumably tuffs. The limestone cuestas rise in the northeastern third of the island, and are separated from the chert cuesta by a rather broad medial lowland which traverses the island obliquely from coast to coast. So much for the form of the island: let its origin as indicated by its structure be next inquired into.

The Basal Volcanic Rocks

The southwestern district appears to represent the marginal part of a volcanic island that was built up chiefly by subaerial eruptions; the lower agglomerates are interpreted as subaerial deposits: the lower tuffs contain no marine fossils as far as known, and are only rarely interbedded with thin calcareous lenses holding marine fossils. The island thus formed must have subsided during the later stages of its volcanic activity at least, for according to the latest and fullest geological report (1923), the higher volcanic beds, a thousand feet or more in thickness, include "water deposited and stratified tuffs . . . . with intercalcations of [locally developed] marine and fresh water limestone. . . . . At intervals during the deposition of these beds there must have been long periods unbroken by any volcanic eruptions. This is proved by the existence of beds of marine limestone and chert enclosing remains of corals which can not flourish except in waters free from external detritus." Various shallow-water molluscs are also preserved in these beds. Next follows a rather heavy series of fresh-water cherts with thin beds of limestone and marl; the cherts contain a large amount of silicified wood, "both monocotyledons and dicotyledons . . . sometimes . . . a foot in diameter," and "abundant

fresh-water gasteropods." These beds are supposed to have been deposited in ponds near the base of intermittently active volcanoes; they imply that, in spite of earlier subsidence, the temporarily submerged flanks of the island were built up again above sea level by later eruptions.

The cherts are followed by a heavy series of weaker beds and these are covered by deposits of gravels of moderate thickness, including pebbles of volcanic rocks and silicified wood. "The heterogeneity of the deposit would point to its being a beach deposit laid down under the influence of strong currents and tides in an epoch of subsidence between the [preceding] fresh-water lagoon phase and the [following] more open water limestone phase;" and these overlying limestones clearly prove that, in spite of previous upbuilding of volcanic eruptions, the island was eventually submerged by subsidence. Their testimony deserves fuller consideration.

THE OVERLYING CALCAREOUS ROCKS

The subsidence, already measuring thousands of feet since the formation of the lowest intercalcated coral-bearing limestone beds in the tuff deposits, must have been long continued, for above the gravels and separated from them by a slight disconformity, comes a great upper series of Oligocene marls and limestones, at least 1,500 feet thick, and very probably thicker still if the uppermost beds which now lie under water off the northeast coast are included. In view of this date for the deposition of the upper strata, the basal volcanic rocks may be of Eocene eruption. According to the report of 1923, the limestones contain "a fossil fauna as noted for its variety as for its abundance. . . . This fauna is essentially a marine one and consists of compound corals, lamellibranchs, foraminifera, calcareous algae, gasteropods and echinoderms. . . . . The commonest lamellibranchs are species of Ostrea and Pecten, the former often reaching a very large size. The algae are chiefly represented by species of Lithothamnion. . . . The compound corals are represented by genera too numerous to mention." The presence of corals within the area of the limestones makes it probable that the outer margin of that area was rimmed by a coral reef, and that the limestones are lagoon deposits. An earlier observer (1919) notes that a fossil coral reef which he found at the disconformable base of the heavy limestone series "grew upon a basement that had been subaerially eroded and was later depressed below sea level;" and that the overlying limestones were "deposited in shoal water on a flattish floor."

There can be no question that a long-continued subsidence was in slow progress while these overlying beds were accumulated, for their fossils are similar throughout; and it is highly probable that, as above implied, the "flattish floor" on which the beds were deposited was that of a shoal-water lagoon enclosed by an upgrowing barrier or atoll reef.

The heavy sedimentary series as well as the underlying volcanic series is here and there entered by dikes, and is in at least one locality interrupted by agglomerates, which are interpreted as having been poured out upon the underlying beds and buried by the overlying beds; but the small volume of these high-level volcanic rocks of late intrusion or eruption is negligible in comparison with the great volume of the sedimentary series. Hence, while the earlier phase of the long-continued subsidence witnessed a more or less frequent production of volcanic agglomerates and ash beds alternating with occasional marine calcareous deposits, the later phase of the subsidence was accomplished, as far as the part of the original mass now seen in the beveled island is concerned, almost without eruptions and was rarely disturbed even by deep-seated intrusions. During this later phase, the original volcanic island seems to have been wholly submerged, for limestones and marls alone were then deposited. Their accumulation was at last interrupted, at least for the southern part of the atoll now represented by the island, by an uptilting which introduced an era of erosion still in progress. As the upper limestones are of Oligocene date, the era of tilting and erosion probably occupied the remainder of Tertiary and later time.

THE TILTED-DOWN PART OF THE ATOLL

The non-emerged part of the atoll is to-day represented by an extensive submarine bank, 5 miles wide on the east and 10 miles on the west of the island, and extending over 30 miles to the northeast; on the farther part of this bank a small and low limestone island, probably of Pleistocene deposition and of recent uplift, is found. It is eminently possible that the northeastern part of the atoll was tilted down when the southwestern part was tilted up; and if so, reef upgrowth and lagoon deposition may have continued in the northeast, thus building up the present bank, while the uptilted southwestern area was suffering degradation; but it is also conceivable that, as Fig. 2 suggests, a gentle flexure separated the uptilted southwestern part of the atoll from a little depressed northeastern remainder. With these possibilities, however, we are not especially concerned.

THE EMBAYED SHORE-LINE AND THE HEADLAND CLIFFS

After the era of degradation was well advanced on the uptilted island, a submergence of moderate measure took place, shown by the change from the broken to the dotted sea-level line in Fig. 2, for the present

shore-line is elaborately embayed. This involved a significant diminution in the size of the island, for its probable northeastward extension in a worn-down lowland now makes part of the shallow submarine bank, above mentioned. The embaying submergence is ascribed to actual subsidence of the maturely degraded island—not to the Postglacial ocean rise into valleys eroded on a still-standing island, while the ocean was lowered in the Glacial epochs of the Glacial period—because the valleys that are occupied by the present embayments even in the more resistant volcanic rocks are thought to be too broad to have been eroded during those epochs.

The headlands of the degraded and embayed island are moderately cut back in cliffs, but the recession of the cliffs is so small that their abrasion can not have been in progress for nearly so long a time as that occupied by the subaerial erosion of the widely opened and partly embayed valleys; for it is well assured that unrestricted abrasion of oceanic islands is a rapid process compared to their subaerial degradation. Hence valley erosion must have been begun relatively long ago and must have continued for a relatively long period, while cliff abrasion must have been a late and brief process.

The cliff faces that were cut in resistant rocks plunge below present sea level; and it is therefore believed that these cliffs have been partly submerged. It is also believed, in view of the long period of valley erosion without cliff cutting, followed by a short period with cliff cutting, that the cliffs were cut by low-level abrasion during the temporary depressions of the ocean in the Glacial epochs of the Glacial period, as will be further stated below; and hence that their partial submergence to-day is largely due to Postglacial ocean rise, and not alone to island subsidence. Similar cliffs cut in weak-rock headlands appear to have been recently cut back farther at present sea level, and are therefore not now seen as plunging cliffs. If the plunging, hard-rock cliffs really represent nearly all the work that abrasion could accomplish, while reef growth was inhibited in the Glacial epochs of lowered ocean temperature and level, then it is all the better proved that nearly all the much greater work of eroding the now-embayed valleys took place during a higher stand of the island in Preglacial time, and that their embayment is due to island subsidence of late date.

The discontinuous fringing reefs that to-day skirt the island shores, as well as the alluvial delta plains that extend inland from the present bay heads and the beaches that swing in curves concave seaward between the volcanic headlands of the southwestern coast, are all believed to be chiefly of Postglacial date. Their Interglacial predecessors would have been largely removed by low-level erosion in the Glacial epochs. It is interesting to note that the beaches, although occupying reentrants between headlands of volcanic rocks, are composed largely of calcareous sand, which must therefore have been swept in from the off-shore bank.

EVIDENCE FOR THE FORMER EXISTENCE OF AN ATOLL REEF

Although the uptilted limestones of the supposed atoll include, as already noted, a number of coral reefs of small thickness which may be regarded as having been intermittently formed in the lagoon area, the enclosing atoll reef, which should be of continuous growth and of great thickness, has not been identified. The discovery of such a reef in the strata of an uptilted and beveled-off island would be a very agreeable confirmation of the belief that its limestones were deposited in the lagoon of an ancient atoll; but the position of the tilted limestones with respect to their ancient volcanic foundation and to the present-day circuminsular bank is such as to make even the expectation of such a discovery unreasonable. The margin of the atoll lagoon where an encircling reef should be found would now stand either high in the air along the southwestern side of the island, where it must have long ago been destroyed by erosion as indicated in Fig. 2, or a few miles off shore in the submarine bank east or west of the island, where after degradation and low-level abrasion it must now be submerged out of reach of observation. The strata of the island being lagoon strata, only discontinuous lagoon reefs are preserved in them.

So long as the atoll reef is not directly shown to have existed, it may not be apparent why the limestone area of the island should be interpreted as representing a reef-enclosed lagoon, instead of a rimless bank. Several reasons for the adopted interpretation may be adduced. In the first place, the presence of fossil coral reefs in the tilted limestones shows that temperature and other conditions were fitted for the growth of reef-forming corals during the period of limestone deposition; and this makes the occurrence of an encircling reef plausible at least. In the second place, the small measure of headland cliff-cutting already noted around the island shore in comparison with the large measure of valley erosion over the island surface demonstrates that, after the period of uptilting, the resulting island must, in spite of the discontinuous development of fringing reefs around it to-day, have been well protected by fringing or barrier reefs during most of its long period of erosion; and a similar demonstration of the former long-continued presence of protecting barrier reefs is furnished by other maturely dissected and well-embayed but little cliffed volcanic islands not far

away. Thus the presence of bank-margin reefs during the earlier period in which the now tilted limestones were accumulated, already shown to be possible by the occurrence of bank or lagoon reefs in the limestones, is made reasonable by the inferred presence of protecting bank-margin or barrier reefs during most of the later period in which the tilted limestones were degraded. Reefs appear to have been wholly absent only during the Glacial epochs of lowered sea level, when the headland cliffs were abraded. In the third place, a neighboring island, composed wholly of limestones evenly uplifted to a moderate height, has been ingeniously interpreted (1867) as representing the lagoon deposits of a former atoll, the marginal reef of which has been cut away by the sea since its uplift. Evidently, the inferred occurrence of a former atoll in the neighborhood of the tilted-up and beveled-off island gives support to the belief that it also was an atoll before it was uptilted. But even if the upper calcareous strata accumulated on a rimless submarine bank, the accumulation must have taken place in shallow water upon a slowly subsiding foundation, and not upon a deep and stationary foundation, shoaled by aggradation as postulated in the Rein-Murray theory.

Absence of an Encircling Reef To-day

If the now uptilted limestones were reef-encircled during their deposition, it might be expected that the beveled-off island and its northward continuation in a shallow bank should be encircled by an off-shore barrier reef to-day, even if they were without reefs during the Glacial epochs. So they should be, if they were situated in a warmer part of the ocean; but they happen to lie in the marginal belt of the coral seas, where they and their neighbors are, even in the present Postglacial epoch, bathed in waters that are hardly warm enough for the vigorous upgrowth of bank-margin reefs, although they do permit the formation of discontinuous fringing reefs near the island shores. This is a general aspect of the problem which I have treated elsewhere[1] and will therefore not enter upon here; it involves the conclusion that Postglacial time is not so favorable for reef growth around these islands as Preglacial and Interglacial times were; a conclusion which finds support in various studies of the climate of those time-intervals based upon Glacial and Interglacial deposits in other regions.

The Tilted-up and Beveled-off Atoll is Antigua

The island which is here interpreted as a tilted-up and beveled-off atoll has not been named thus far, because I have wished the reader to consider the problem it involved independently of any opinions he may have previously formed about the island itself. Now that the problem has been set forth, the mask of anonymity may be discarded: the island is Antigua in the Lesser Antilles, and the observers above quoted may be identified among others in the list given below by the dates of their published articles.[2] The volcanic base is of early Tertiary eruption; the atoll superstructure is of mid-Tertiary deposition; and the revelation of the atoll structure is due to later Tertiary tilting and erosion. The neighboring island that was interpreted half a century ago as an evenly uplifted and much abraded atoll is Sombrero.[3]

Confirmation of the idea that protection of the Antigua coast by encircling reefs has long been prevalent and that the temporary absence of such reefs occurred only during the Glacial epochs of the Glacial period is given by the Virgin Islands as well as by St. Lucia and several other members of the Lesser Antillean volcanic chain, where the hard-rock headlands between the embayments which enter mature valleys eroded in the same hard rocks are only moderately cut back in plunging cliffs.

The thickness of the volcanic and calcareous strata seen in the beveled surface of Antigua is at least five and probably eight times as great as the depth of the famous boring in Funafuti atoll of the Ellice group in the central Pacific; and the opportunity for the study of atoll understructure is immensely superior on Antigua to that afforded by the small boring-core from Funafuti, the interpretation of which has produced rather more dissension than demonstration; for the successive deposits of Antigua, from the lowest volcanic beds to the highest limestones, are open to examination in many outcrops along the strike of the strata over distances of from 5 to 12 miles. The evidence that they give for long

[1] The marginal belt of the coral seas. *Amer. Journ. Sci.*, vi, 1923, 181-195.

[2] P. T. Cleve. "On the geology of the northeastern West India islands." Handl. Svensk. Vetensk. Akad., ix, 1871.

J. C. Purves, "Esquisse géologique de l'île d'Antigoa." Bull. Mus. roy. hist. nat. Belg., iii, 1884, 273-318.

J. W. Spencer, "On the geological and physical development of Antigua." *Quart. Journ. Geol. Soc.*, lvii, 1901, 490-505.

A. P. Brown, "Notes on the geology of the island of Antigua." Proc. Acad. Nat. Sci. Phila., 1913.

T. W. Vaughan. ". . . An account of the American Tertiary, Pleistocene, and recent coral reefs." U. S. Nat. Museum, Bull. 103, 1919, 189-524.

K. W. Earle. "Report on the geology of Antigua." "Antigua," 1923.

[3] A. A. Julien. "On the geology of the Key of Sombrero." Ann. Lyc. Nat. Hist. New York, viii, 1867, 251-278.

continued and relatively slow subsidence is indisputable.

As far as I have learned, only one earlier observer, Purves, a Belgian geologist, has regarded Antigua as a tilted-up and beveled-off reef-enclosed island, and even he does not appear to have explicitly stated that it reached the atoll stage of development, although he comes so near to describing such a stage that one must suppose he understood it, mentally at least. His most definite statement is as follows:

> La puissance de cette vaste formation calcaire indique qu'elle s'est déposée pendant une longue période d'affaissement du sol qui a suivi l'extinction de l'activité volcanique et pendant laquelle des récifs de coraux très-étendus se sont librement établis autours des bancs formés par les matériaux volcaniques éjectés lors des dernières éruptions. Ces roches, actuellement visibles, ne représentent pas la substance même du récif, car, pendant la formation du dépôt, ce récif devait être situé à une distance considérable de la côte. Ces amas de marnes et de calcaires avec leur masse de débris de coraux détachés mais très-bien conservés, de bois flotté et échoué, de coquilles et d'orbitoides, représentent évidemment le dépôt particulier que l'on voit encore de nos jours se former par l'accumulation entre la barrière de récifs et les côtes d'une île affectée d'un mouvement d'affaissement lent et continu ('84, 307).

In spite of this clear indication of the association of the Antigua limestones with an ancient barrier-reef system and the explicit recognition that the ancient reef is not now visible, the island has not gained the reputation that it deserves as a tilted-up and beveled-off atoll. Several observers of later date than Purves do not make so close an approach to imputing this origin to it as he did.

Antigua has many features of interest, which I enjoyed seeing during a ten-day visit in November, 1923. Its lower lands of fertile calcareous soil have long been cleared and cultivated, sugar cane being the chief crop. English harbor, an embayment on the southern coast between slightly cliffed headlands of submountainous form, back of which rises a well-defined tuff cuesta, was at one time strongly fortified as the chief British naval base in the West Indies; it was there that Nelson refitted his fleet after an engagement with the French in an early year of the nineteenth century. St. Johns, the chief town of the island to-day, was an excellent center for my excursions, which were all the more pleasant from the competent guidance by hospitable officials and residents with whom I made acquaintance. The town lies at the head of an open embayment which enters the northwestern end of the broad medial lowland worn down across the island on the weak beds between the cuestas of the underlying cherts and the overlying limestones; the other end of the medial lowland is entered by Willoughby bay, across which the limestone cuesta on the north affords a delightful view. Many of the physiographic features above described may be reviewed to advantage from the crest of the main chert cuesta which serves as a delightful Belvidere near the center of the island; and not the least interesting consideration that might be broadly enjoyed in the prospect there opened or more closely reviewed during an examination of the inclined tuffs and limestones in their many outcrops would be the contemplation of the island as a tilted-up and beveled-off atoll; but the conscious contemplation of Antigua as of that origin was denied me; for in spite of my ten-day exposure to the contagion of the infectious facts, a four-month period of unconscious incubation elapsed before the explanation of the facts as here presented "broke out" upon me. It then appeared that the deep understructure of the island agrees, as far as it is now revealed, in every essential respect with the understructure that an atoll, formed according to Darwin's theory of slow upgrowth from a slowly subsiding foundation, should possess.

W. M. Davis

Harvard University

THE FISHERIES BIOLOGICAL LABORATORY, WOODS HOLE, IN 1923[1]

When the laboratory was opened on June 20 three investigators of the bureau's regular staff who had been at the station during the greater part of the preceding winter and another who had arrived early in June were already there engaged in investigations which had begun at or through the laboratory in the preceding summer and continued without interruption.

The temporary official staff of the station consisted of the director and one scientific assistant. The laboratory enjoyed the hearty cooperation of Superintendent W. H. Thomas and the general staff of the station under his direction. Invaluable service to the director and to investigators was rendered by Robert A. Goffin, collector, and by the fisheries steam launch, *Phalarope,* with Robert Veeder as master. Helpful service was rendered in the office and library by Allan A. Grafflin, and in art work by Kenneth G. Phillips, under the War Veterans Bureau. In addition to the *Phalarope,* employed for longer trips, two smaller launches and a number of rowboats were available.

In all, there were in the laboratory 28 investigators and assistants, of whom 14 were engaged upon official work and 14 upon independent studies. There fol-

[1] Published by permission of Mr. Henry O'Malley, United States Commissioner of Fish and Fisheries.

lows a list of the investigators and topics of investigation. Results are given in a few instances, selected not with special reference to the merits of the particular researches, but rather with a view to better illustrating the type of investigation and the general interest of the work pursued in the Fisheries Laboratory.

Charles J. Fish, general assistant, of the *Albatross*, who had been attached to the laboratory throughout the preceding year, continued his investigation of the daily and seasonal variation in the plankton of the Woods Hole region. The work until July had consisted of daily observations on physical conditions and plankton collections taken from the end of the Fisheries dock. Beginning with July of the past summer, and employing the *Phalarope*, similar observations have been made at regular intervals throughout Vineyard Sound and Buzzards Bay, with the primary purpose of studying the horizontal distribution of the various planktonic organisms. The unusually cold weather prevailing throughout the previous spring was found to have had a notable effect on the plankton of the region. Almost all the pelagic forms appeared later than usual. The diatom swarm that in 1922 appeared on June 15 arrived in Great Harbor this year on August 9. Some animals that were comparatively common during the preceding summer did not appear at all in the summer of 1923. The effect of the temperature on the breeding seasons of invertebrate animals was distinctly observable in Vineyard Sound, where in the deeper waters temperatures were found in August to compare with temperatures at Woods Hole in Great Harbor in late May and June, and where at the same time the plankton was found to be identical with that of Great Harbor in May and June. All observations indicate that temperature is the dominant factor governing the seasonal distribution of the local plankton fauna. Dr. Fish's data and conclusions will appear in publications of the bureau.

Mrs. Marie D. Fish, field assistant of the Bureau of Fisheries, is engaged in studies of the identification and seasonal distribution of the larval fish of the Woods Hole region, having available material collected daily at Woods Hole and at certain intervals in Buzzards Bay and Vineyard Sound and in the waters of the sea immediately without the sound, as well as collections made at the station in past years by the late Vinal Edwards, by Robert A. Goffin and by others. She has also assisted Dr. Fish in his plankton studies.

Paul S. Galtsoff, naturalist of the *Albatross*, was engaged primarily in examination of data and materials collected in the biological and hydrographic reconnaissance of Long Island Sound that he has been conducting since June, 1922, with the use of the Fisheries Steamer *Fish Hawk*. Salinity determinations (by titration) were made upon 500 samples of water previously taken in the sound, and the volume of the plankton was determined for 275 quantitative samples of plankton. He made a comparative test of the centrifuge method and the filtering method (sand filter) as employed in microplankton examinations, finding that the sand filter method yielded more accurate results. He made also a study of the food of oysters from Wareham River, Buzzards Bay, finding (in June) that it consisted chiefly of bottom-living diatoms. In cooperation with Mrs. Galtsoff, he continued investigations of regeneration of silicious sponges after their dissociation. It was learned that Ca-ions are necessary for the formation of the aggregates of separated cells, that alkaline sea water (pH 9.8) increases adhesiveness of protoplasm and facilitates to a certain extent the formation of aggregates of cells from different species, and that the rebuilding of a new organism from a clump of cells depends on the stereotropic reaction of the cells. The histology of the regenerative process was also studied.

J. Paul Visscher, special assistant of the Bureau of Fisheries in cooperation with the Department of the Navy, was engaged in a study of the fauna and flora of ship's bottoms and the factors affecting attachment of organisms to the bottoms. By expeditions to various ports, on notification of arrivals, he examined 15 vessels in course of the summer, supplementing observations made in a similar manner during the preceding winter and spring. The materials collected were studied at the laboratory, where he also conducted experiments to determine the reactions of fouling organisms to light and to color of substratum. It was determined for certain specific forms that the larvae at the time of attachment are negative to light, and it was also found that steel plates submerged in a tidal current incurred less fouling if painted in lighter colors. He also conducted studies of the life history and distribution of barnacles and determined for three species the resistance when exposed to fresh water and to air.

Professor Charles B. Wilson, of Massachusetts State Normal School, Westfield, Massachusetts, assisted by John E. Wilson, temporary assistant, examined a collection of free-swimming copepods made by Dr. R. P. Cowles in course of the survey of Chesapeake Bay that he conducted with the use of the Fisheries Steamer *Fish Hawk* during the years 1920 and 1921. The collection comprised about 700 hauls made at 35 separate stations at different times of the year, at different hours of the day and night, at different depths, and under different conditions of tide, salinity and temperature of water, as well as with nets of various sizes of mesh. They examined

all the hauls, recorded the different species of copepods found in each, calculated the total numbers of individuals in each haul and the relative number of individuals of each species represented. By incidental examinations of local fishes they secured 25 species of parasitic copepods, including four or five new species and one new genus, which will be more fully described at a later time.

The four major investigations of the bureau, of which account has just been given, were all concerned in some way with the small floating or swimming organisms of the sea and its bays and with the conditions affecting the distribution and abundance of such organisms. The investigations were not cooperative; each was entirely independent of the others; but, whatever the original purpose of each study, the results of all must link together to form a broad contribution or series of related contributions to knowledge, (1) of the geographic, local and seasonal distribution of marine and semi-marine plankton organisms, (2) of the effects of the physical conditions of the sea upon the distribution and abundance of such organisms, and (3) upon the seasons and the success of the breeding of marine animals in general. The usefulness and the interest of such studies are obvious, both to those whose interest lies primarily in the discovery of principles of biology and to those who would be able to interpret and to forecast the relative abundance of food fishes at particular times and places; for in the plankton or floating life in the waters is comprised not only "the pasturage of the sea," but, it may be said, the great nursery for nearly all animals of the ocean and its shores and bottoms.

The director of the laboratory, assisted by James T. Penney, obtained a considerable body of material for study of the natural history of Limnoria, the conditions of breeding, and the structural and physiological differences correlated with differing environmental conditions. This study is in continuation of studies in progress based upon material collected at Beaufort, N. C. It is evident that, correlated with the shorter breeding season at Woods Hole, as compared with Beaufort, N. C., the broods of young are much larger in number of individuals in the colder northern waters. The director also made observations in waters of Cape Cod supplemental to previous studies of hydrogen-ion concentration of natural waters as a factor affecting the distribution of freshwater fishes.

The director of the laboratory acted as leader of a party of thirty naturalists from the Fisheries Laboratory and the Marine Biological Laboratory, which made a zoological reconnaissance of Penikese Island with reference to animal life above the tide line. The materials collected were subsequently assorted and distributed to specialists for study and identification. It is hoped that a report may be completed within a year to be published possibly in conjunction with a report of the botanical survey of the island made a few days earlier. The two surveys were undertaken in observance of the fiftieth anniversary of the founding by Louis Agassiz upon Penikese Island of the first marine biological station in America. The observance, by the surveys and otherwise, was initiated by the Marine Biological Laboratory of Woods Hole.

INVESTIGATIONS BY OCCUPANTS OF TABLES

Dr. F. E. Chidester, of West Virginia University, engaged in study of the literature of fish migration and the possible factors affecting it, including hydrogen-ion concentration. He made experiments to develop methods of determination of small quantities of oxygen and carbon dioxide in the blood of fishes, and spent some time in anatomical studies relating to the brain of the blue shark and to other organs of vertebrates.

Dr. N. A. Cobb, of the U. S. Department of Agriculture, with four assistants, investigated the physiology of nemas, especially that of the alimentary tract, with the use of polarized light and *intra-vitam* staining, and by direct observation of the feeding and other habits of nemas. For this purpose he introduced the application of modified petrographic microscopes with decidedly advantageous results. Marine nemas were employed for his studies, because the general physiology is the same in principle as that of the plant-infesting and the soil-inhabiting forms under investigation by the Department of Agriculture while, in size and transparency, the marine forms are far more favorable to such investigations than are the smaller forms in more direct contact with crops of the land. Furthermore, he finds that at the Woods Hole laboratory the marine forms are far easier to collect in sufficient quantity and variety. Incidentally, the examinations were extended to other phyla—to nearly all the animal phyla, in fact. It is thought that the results of the incidental work, which was much aided by eminent specialists at Woods Hole, may in future be the stimulus for much fundamental physiological investigation inside the cell.

Paul S. Conger, of the United States National Museum, assistant to Dr. Albert Mann, specialist in diatoms for the Carnegie Institution of Washington, spent six weeks at the laboratory making collections of diatoms, chiefly marine, as material necessary to continue the studies that Dr. Mann has been conducting for several years relative to the diatom flora of Woods Hole.

Dr. John C. Hemmeter, of Baltimore, Maryland, studied the comparative histology of the abdominal organs of the selachians obtainable at Woods Hole

with special attention to digestive organs—stomach, pancreas (including islets of Langerhans), and liver —and to their reciprocal relations in hematopoiesis and hemolysis with the spleen. In connection with the histological studies, the osmotic phenomena and histology of the blood itself was investigated. Mrs. Hemmeter aided in histologic work and in preparing drawings from microscopic preparations.

Miss Catherine Indorf, of the University of Missouri, studied with Dr. Cobb the structure and habits of nemas, and the technique of their investigation, with the special view of obtaining a knowledge of the technique to be applied in the investigation of a serious agricultural pest in northern Missouri, *Heterodera radicicola*.

Dr. Edwin Linton, of Augusta, Georgia, continued his systematic studies of the internal parasites of fishes, giving attention not only to the final hosts of the parasites but also to intermediate carriers as well, including invertebrates, fish-eating birds and fishes.

Dr. G. A. MacCallum, of Baltimore, investigated parasites of fishes, chiefly sharks, with special reference to trematodes of the gills and nasal glands. He also collected parasites from turtles and other reptiles, obtaining some new forms, which will be studied and reported upon at a later time.

Thomas F. Morrison, of Princeton University, examined many different forms of marine animals for fluorescence. It was found that the phenomenon of fluorescence is very widespread, but, due to pigmentation present, it is not perceptible in all cases. Clear protoplasm, such as is found in the embryonic tissues, exhibits a light blue fluorescence, while similar tissues from adults exhibits a greater variety of fluorescent colors. Various body fluids were found to be fluorescent, the fluorescence of the decomposition products being especially marked. The chemical nature of these substances was studied, and it was found that practically all groups of biochemical compounds contain fluorescent members. The source of light used in these experiments was a carbon arc and glass filter. The incident light was rich in ultraviolet to 350 $\mu\mu$ but weak beyond 300 $\mu\mu$. The upper limit was 425 $\mu\mu$.

During a brief stay at the laboratory, Professor A. M. Reese, of West Virginia University, worked upon the structure and development of the oral glands of certain pit vipers.

L. R. Safir, of Columbia University, continued genetic researches with the use of *Drosophila melanogaster*. His particular problem was to locate more definitely in the third chromosome the loci of some 8 or 10 factors. Crosses involving upward of 30,000 offspring were carried out. He also studied the effect of X-rays on the offspring derived from a Mendelian cross, arriving at the general conclusion from genetic evidence that the X-raying of the flies caused a disturbance in the sex or X chromosomes so that they do not disjoin.

Dr. Henry C. Tracy, of the University of Kansas, studied the development of reactions in teleost embryos and larvae, with particular reference to chemical and physical factors influencing the early movements of teleost larvae.

Professor H. V. Wilson, of the University of North Carolina, with Henry V. Wilson, Jr., was at the laboratory for a few days obtaining material for histological studies of sponges.

R. E. COKER,
Director

UNIVERSITY OF NORTH CAROLINA

SCIENTIFIC EVENTS

THE NATIONAL MUSEUM OF ENGINEERING AND INDUSTRY

ONE million dollars has been assured towards the establishment of the National Museum of Engineering and Industry, Incorporated, with headquarters in the Engineering Societies building. A campaign to raise an additional nine million dollars has been started. The president of the new organization is Dr. Elihu Thomson, who recently received the Kelvin Gold Medal from the Royal Society at the Kelvin centenary in London. The vice-presidents are Dr. Edward G. Acheson, one of the creators of the modern abrasive industry, Dr. Leo H. Baekeland, inventor of velox paper and bakelite and president of the American Chemical Society, and Dr. Edward Weston, creator of the Weston type of electrical instruments. Its trustees are Mr. Philip T. Dodge, chairman of the International Paper Company; Mr. Howard Elliott, chairman of the Northern Pacific Railroad; Dr. Ira N. Hollis, president of the Worcester Polytechnic Institute; Dr. Elmer A. Sperry, president of the Sperry Gyroscope Company, and Mr. Worcester R. Warner, of Warner & Swasey, Cleveland, Ohio, makers of telescopes. Mr. George E. Roberts, vice-president of the National City Bank, is treasurer and Mr. H. F. J. Porter, industrial engineer, is secretary.

In cooperation with the Smithsonian Institution the new organization is planning to erect on its grounds in Washington a building to house the original models of early inventions and the records of constructive achievement of pioneers, inventors and engineers in the development of transportation and industry. In this way the United States will be given the kind of institution which all the great European nations have possessed for years, and in the layout of the proposed museum use will be made of the data collected by an expert who has recently returned from a year's survey of museum practice abroad. An important de-

parture in the American scheme is proposed, however, made necessary by the vastness of the country. In addition to the central collection at Washington special collections such as replicas of the historical exhibits will be carried to the people, also the machinery of modern processes will be placed in affiliated museums in industrial centers of every state.

Incorporation was effected in March last under the laws of the District of Columbia by the "Organizing Committee of 100" composed of chairmen of boards of directors, presidents and chief engineers of industries and railroads, and professors of engineering and history in universities and colleges.

HELMHOLTZ'S PHYSIOLOGICAL OPTICS

IT is announced that the first volume of the English translation of Helmholtz's *Handbuch der Physiologischen Optik,* prepared under the editorship of Professor Southall, of Columbia University, and published by the Optical Society of America, is now ready for distribution. The importance of this work as one of the monuments of scientific creation is universally recognized, but this translation is inspired by a realization of its present value to scientific workers and not merely of its historical significance. Although of course many things in it have become antiquated, there are also many that have been overlooked or neglected, and whose value has not been diminished by subsequent research. Moreover, there is no other book, nor even any combination of books, in which anything comparable to it as a conspectus of the whole subject can be found.

In selecting for translation the third (and latest) edition, 1909–10, the editor has in large measure been influenced by the incorporation in that edition of most valuable appendices by v. Kries, Nagel and Gullstrand; and besides these appendices the English translation will include (in the first volume) an entirely new chapter on ophthalmoscopy taken from Professor Gullstrand's *Einführung in die Methoden der Dioptik des Auges des Menschen.* Since, on the other hand, the third edition (based by v. Kries and Nagel on the first) omitted the very important work of König, done in direct development of Helmholtz's ideas and incorporated in the second edition, this phase of the subject is briefly treated in an appendix (to appear in the second volume) by Christine Ladd-Franklin, which will also contain a critical examination of the Helmholtz and Hering theories of color vision and a concise exposition of her own theory. The time of the publication of the second and third volumes is not yet fixed. The edition is limited to one thousand copies. Orders should be placed with F. K. Richtmyer, Cornell University, Ithaca, N. Y.

THE SECTION OF PHYSIOLOGY OF THE BRITISH ASSOCIATION

OVERSEA members of the British Association for the Advancement of Science coming to the Toronto meeting, beginning August 6, include the following:

President of Section I—H. H. Dale, head of the department of biochemistry and pharmacology, Medical Research Council, London. Former director of the Wellcome Physiological Research Laboratories. His presidential address will deal with "Progress and prospects in chemotherapy."

Vice-president—G. H. F. Nuttall, Quick professor of biology, Cambridge. Editor and founder of the *Journal of Hygiene* and the *Journal of Parasitology.*

Recorder—Dr. C. Lovatt Evans, of the department of physiology, St. Bartholomew's Hospital Medical College, London, will discuss "The physiology of muscular contraction in relation to efficiency and fatigue."

Secretary—E. P. Cathcart, Gardiner professor of chemical physiology, University of Glasgow, and adviser in physiology to the War Office, will deliver a paper on the "Respiratory quotient," and a popular lecture on "Seeing is believing" and will discuss "Energy exchange in relation to muscular performance in laboratory investigations."

J. H. Burn, of the biochemistry department of the Medical Research Council, London, will speak on "The factors controlling the normal output of sugar from the liver."

S. Monckton Copeman, medical officer, Ministry of Health.

J. C. Drummond, of University College, London, will give a popular lecture on the "Importance of the infinitely small in nutrition," and will speak also on "Modern tendencies of vitamine research."

Sir Henry Gauvain, medical superintendent to Lord Mayor Treloar's Cripples' Hospital and College, will discuss light therapy in the symposium on "Vitamines and the relation of light to their action."

E. Mellanby, St. Thomas Hospital, London.

J. S. Owens.

Sir J. Herbert Parsons, surgeon of the Royal London Ophthalmic Hospital, optical surgeon in University College Hospital and a member of various government committees.

H. E. Roaf, professor of physiology, London Hospital Medical College, will give papers on "Color vision" and on "Urinary pigments."

Alfred Herbert Tubby, consulting surgeon, especially on diseases of children.

THE EDWARD HART CELEBRATION AT LAFAYETTE COLLEGE

DR. EDWARD HART has now completed fifty years of service in connection with the chemistry department of Lafayette College and it is proposed to cele-

brate the event on October 16, 17 and 18 by an intersectional meeting participated in by the Lehigh Valley section, the New York section, the Philadelphia section, the Wilmington section and the South Jersey section of the American Chemical Society. This time is chosen because it immediately follows the centennial celebration of the founding of Lafayette College with a pageant on October 15.

On Thursday afternoon the general theme "Fifty years of chemistry in America" will be discussed by Dr. Edgar F. Smith, Dr. Harvey W. Wiley, Dr. William H. Nichols and Dr. Bradley Stoughton. In the evening there will be a dinner in honor of Dr. Hart. Friday will be devoted to a plasticity symposium during the entire day. Our knowledge of plasticity is very defective, but the science of the flow of matter is fundamental to an understanding of colloid chemistry and many industries have plasticity problems which urgently demand solution, so it is hoped that the conference will be of benefit. On Saturday there will be excursions to different points of the Lehigh Valley: (1) Cement and slate industries and the Delaware Water Gap. (2) Chemical and metallurgical industries of Easton and Philipsburg. (3) Lehigh University of the Bethlehem Steel Company. (4) The New Jersey Zinc Co., at Palmerton, Pa.

Correspondence should be addressed to Professor Eugene C. Bingham, Lafayette College, Easton, Pa.

SCIENTIFIC NOTES AND NEWS

IN recognition of his nomination for the presidency of the American Society of Mechanical Engineers, and of his imminent retirement from the position of head of the department of mechanical engineering at Stanford University, Professor William F. Durand was entertained with a dinner in his honor on June 18, under the auspices of the Stanford branch of the American Society of Mechanical Engineers.

DR. ALBERT F. BLAKESLEE, plant geneticist at the Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y., has been elected a corresponding member of the Dutch Botanic Society.

PROFESSOR MICHAEL I. PUPIN has received the honorary degree of doctor of science from Princeton University.

DR. FRANK BILLINGS was awarded the honorary degree of LL.D. at the recent convocation at the University of Cincinnati.

THE *Journal* of the American Medical Association reports that as a result of the general election in Japan held on May 10 fifteen medical candidates secured seats in the lower house. These include Dr. Milzinosuke Miyajima, director of the Kitasoto Institute for infectious diseases.

DR. EDWARD MELLANBY, professor of pharmacology at the University of Sheffield, has been awarded the Stewart Prize of the British Medical Association for work on the relation between rickets and dietetic deficiency.

CHARLES M. UPHAM, state highway engineer of North Carolina, has been recently appointed director of the advisory board on highway research of the National Research Council, to succeed Dr. W. K. Hatt, who has resigned in order to resume his work at Purdue University.

DR. C. W. LARSON has been appointed chief of the new bureau of dairying of the Department of Agriculture created under an act of the last session of congress. The work of the bureau was formerly carried on by the dairy division of the bureau of animal industry of which Dr. Larson was chief.

DR. CHARLES N. GOULD has been appointed director of the Oklahoma Geological Survey.

THORNTON T. MUNGER has been appointed director of the Northwest Forest Experiment Station now being organized in the United States Forest Service.

DR. FRANK D. KERN and Professor H. H. Whetzel have sailed for a two-month stay in the West Indies for the purpose of studying the plant rusts of that region.

PROFESSOR WILHELM STEPP, director of the university polyclinic at Giessen, has been given a six months' leave of absence to study vitamins in the United States, on the invitation of the Rockefeller Foundation.

NORMAN TAYLOR, curator at the Brooklyn Botanic Garden, is spending the summer at Montauk, Long Island, studying the effect of wind on the transpiration and growth of plants. A temporary laboratory has been erected on an exposed part of the Montauk Downs, where the wind movement is among the greatest recorded for any part of the Atlantic Coast.

DR. KAZUMI KAWAMURA, professor of soils and agricultural geology at the Imperial University of Tokio, is spending a five-month period of investigational work in the department of soils, University of Wisconsin. He has been appointed to an honorary fellowship and is pursuing his researches under the direction of Professor Truog.

C. P. LATHROP, junior chemist of the Food Control Laboratory, has resigned from the Bureau of Chemistry, to accept a position as technical adviser of the National Preservers and Fruit Products Association, with headquarters in Washington.

DR. H. M. LEAKE, late director of agriculture of the United Provinces, India, and late principal of the Cawnpore Agricultural College, has been appointed

principal of the Imperial College of Tropical Agriculture, Trinidad, to succeed Sir Francis Watts.

Dr. Harry V. Harlan, of the United States Department of Agriculture, spoke at Kansas State Agricultural College on June 25 on "Agricultural and social conditions in Abyssinia."

Dr. F. W. Upson, chairman of the department of chemistry at the University of Nebraska, will spend the week of November 17 to 22 at the University of Arizona, where he will deliver a series of lectures in the department of chemistry and before the Arizona section of the American Chemical Society.

A memorial, in the form of an endowment of the department of biology, is to be created at Whitman College for Dr. Robert Clark Yenney, at the time of his death professor of medicine at the University of Oregon Medical School.

Sir F. W. Dyson, the Astronomer Royal, in the presence of a large gathering of British and oversea astronomers, recently unveiled a tablet in the Berkshire County Council school, Wallingford, to commemorate the services to astronomy of the late Mr. T. H. Astbury, headmaster of the school for many years.

Benjamin G. Lamme, chief engineer of the Westinghouse Electric and Manufacturing Company, known for his researches and inventions on power problems, died on July 8.

Dr. F. W. Ives, professor of engineering at Ohio State University, died on July 5, aged thirty-nine years, from injuries sustained in the wreck of a passenger train.

Wilfred Campbell, one of the leading turbine engineers in the United States, died on July 7, at the age of forty years.

Dr. Andrew R. Robinson, formerly professor of dermatology at the New York Polytechnic Hospital, died on July 8, aged seventy-eight years.

Dr. Charles Hunter Stewart, professor of public health at the University of Edinburgh, has died in his seventieth year.

The next meeting of the French Association for the Advancement of Science will be held in Liége from July 28 to August 2.

The seventy-second annual meeting of the American Pharmaceutical Association will be held in Buffalo, from August 25 to 31, under the presidency of Professor H. V. Arny, of the Columbia University College of Pharmacy.

The Indian Universities Conference has recommended to the government the appointment of a central advisory board for scientific research.

Orlando Rangel, a pharmacist of Rio de Janeiro, has endowed a fund for a quadrennial prize to be awarded by the Academia de Medicina at Rio de Janeiro for distinguished work in medicine or pharmacy. The prize is to be conferred for the first time on the centennial anniversary of the academy in 1928.

The collection of tenthredinoidea or sawflies, formed by the late Professor Alexander D. MacGillivray, of the University of Illinois, has been purchased by that institution. It includes some four hundred types and one thousand species.

With a record enrollment and new living quarters, the summer session of the Puget Sound biological station of the University of Washington has opened at Friday Harbor for a six-weeks' term. Two laboratory buildings of tile construction and a kitchen and dining hall have been completed in time for the opening of this session. Dr. Theodore C. Frye, of the university, is in charge of the station. He is assisted by Professors Trevor Kincaid and John E. Guberlet, of the university, and three visiting scientists: Professors Harold Kylin, of the University of Lund, Sweden; V. E. Shelford, of the University of Illinois, and E. J. Lund, of the University of Minnesota.

Representatives of the various executive departments and scientific establishments of the government opened a conference at the Navy Department July 1, for the purpose of formulating plans for a naval expedition to undertake investigations in all phases of the science of oceanography. The meeting was opened by Secretary Wilbur and Dr. G. W. Littlehales, hydrographic engineer of the Navy Department, explained the purpose of the projected expedition as serving the varied interests of the navy, commerce and navigation as well as numerous sciences.

A meeting of the research advisory committee of the American Electroplaters Society was held at the Bureau of Standards in June. The status of the various researches on nickel deposition was discussed and suggestions were received for further work in this field. Special emphasis was laid upon the desirability of bringing the manufacturers themselves into closer contact with the results of research, and it was suggested that at some future conference the manufacturers be invited to send their managers or superintendents.

The United States Civil Service Commission announces an examination for assistant entomologists, applications closing on August 12. The examination is to fill vacancies in the Bureau of Entomology, Department of Agriculture, at an entrance salary of

$2,400 a year. The duties of the position are to conduct experiments with insecticides in the control of the Japanese beetle grubs, and in the utilization of bacterial and fungus diseases against the Japanese beetle.

Five-year courses in engineering and science will be instituted at California Institute of Technology, Pasadena, beginning next fall. The longer courses have been planned in order that students may be given a more thorough training. For classes entering next fall and thereafter, the present courses will be replaced by two four-year courses, one in engineering and one in physical science. Completion of either course will bring the degree of bachelor of science. These courses will be supplemented by fifth-year programs in civil, electrical, mechanical or chemical engineering, chemistry, physics, geology and mathematics, for the completion of which the degree of master of science will be awarded.

According to the *Journal of Terrestrial Magnetism* a new magnetic observatory to replace Greenwich is under construction in the uplands of Surrey at Abinger on a site of 10 acres some 20 miles from London; the work is being financed by the Southeastern and Catham Railway, the electrification of which (the railway is within one half mile of the old observatory) made necessary the discontinuance of the work at Greenwich. The new station is in latitude 51° 11′ 03″ north and in longitude 0° 23′ 12″ west at an elevation above sea of 800 feet, the nearest approach of the railway line being 2¾ miles. The buildings include variation observatory, absolute observatory, residence, caretaker's quarters, offices and dynamo and accumulator rooms. Absolute observations at Abinger were begun March 24, 1924, simultaneous with those at Greenwich and will be continued until the electrification of the railway makes it impossible to observe at Greenwich; it is expected that the observations may be continued until the end of 1925.

With the additional appropriations that became available July 1, it will be possible for the Department of Commerce to expand several of its activities, one of which is its work on the non-ferrous metals. While considerable work has been done on these metals, that activity has not been accentuated as much as will be the case from now on. The section is to be reorganized as a division, and will be known as the Minerals Division, since work will be done on other minerals. The work will be under the immediate direction of James A. Stader, who has been chief of the minerals section of the iron and steel division.

We learn from *Nature* that the council of the senate of the University of Cambridge has issued a report on the Jacksonian professorship of natural philosophy, which has been suspended since the death of Sir James Dewar. The professorship is only partly endowed and funds are not available to complete the stipend up to the normal scale. The council, in the hope of attracting a succession of distinguished men of science from outside Cambridge, proposes that the professor shall not necessarily be required to reside and that he should be appointed for one year, the same person not to be eligible for more than two years in succession. This proposal, if adopted, would involve the creation of a new class of professorships in the university not subject to the ordinary regulations governing the regular teaching professors.

An investigation of safety conditions in the oil fields of the country is being made by the Department of the Interior, through the Bureau of Mines. Information will be obtained from the properties visited regarding safety experience and methods and devices used for increasing safety. It is planned to take photographs to illustrate safety articles and bulletins showing safe and unsafe practices; gather and publish accident statistics, and disseminate among operators, foremen and workmen, by personal visits and orally, with more concrete application than written communications would probably provide, the arguments for increased safety in the oil industry.

The new educational unit recently established at the University of Chicago under the name of the Institute of Meat Packing, of which Professor Emery T. Filbey, dean of University College, has been appointed director, is under the general control of a joint administrative committee consisting of seven representatives of the university and four of the Institute of American Meat Packers. The members representing the University of Chicago include James Hayden Tufts, dean of the faculties and vice-president of the university; Leon Carroll Marshall, chairman of the department of political economy; William H. Spencer, dean of the School of Commerce and Administration; Emery T. Filbey, dean of University College; Hervey F. Mallory, secretary of the Correspondence-Study department; Julius Stieglitz, chairman of the department of chemistry, and Charles C. Colby, associate professor of geography. The members of the Administrative Committee representing the Institute of American Meat Packers include Thomas E. Wilson, chairman of the Institute Plan Commission; Oscar G. Mayer, chairman of the committee on educational plans, institute plan commission; William Whitfield Woods, vice-president in charge of the department of education and research, and Willard Eugene Hotchkiss, director of the bureau of industrial education.

IN order to popularize the metric system, the introduction of which into Russia was provided for by a decree of the Council of Commissaries in 1918, an order has been issued making mandatory the sale of fresh milk in ¼, ½ and 1 liter containers, commencing January 1, 1924, and the sale of products widely used by the population in standard packages, in metric units, is now being organized according to *Economic Life,* Moscow. The decree for the introduction of the metric system was to have become effective January 1, 1922, but the date was subsequently deferred with the understanding that the transition to metric weights and measures by all state institutions and private organizations and persons should be carried out gradually and completed by January 1, 1927. Certain industries (textile, leather, sugar, tobacco, starch and glucose, oil-crushing, tea and coffee, chemical, confectionery, canning and yeast) adopted the metric system by January 1, 1924; the leather goods trade by June 1, and the electrical industry will adopt it by November. Metric units should be used in all technical plans and specifications, commencing October 1, 1925, and in all credit and banking accounting, as well as in budgetary specifications, after October 1, 1926. The number of scales and balances of various types now in use in the entire territory of the Soviet Union is estimated at 1,500,000, including 70 per cent. of even scales, which do not require any adjustment for metric weights; 20 per cent. of decimal beam scales; 8 per cent. of centimal lever scales, and 2 per cent. of miscellaneous devices. Thus only about 450,000 balances will have to be remodeled for the metric system. The total cost of the introduction of the metric system, including the casting of 30,000 tons of weights, popularization and instruction, is estimated at 11,200,000 gold rubles.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of Wisconsin will receive $350,000 by the bequest of Thomas E. Brittingham.

GROUND was broken on June 17 for the State University of Iowa's new $4,500,000 medical building, made possible by the state appropriating funds to equal a gift of the Rockefeller Foundation.

PROFESSOR E. C. COKER, head of the department of mathematics of Winthrop College, has been called to the chair of astronomy and mathematics at the University of South Carolina.

MISS LILA SANDS, Ph.D. (Nebraska, '24), has been appointed an instructor in the department of chemistry at the University of Arizona.

DR. RICHARD HARTSHORNE, Ph.D. (Chicago, '24), has been appointed instructor in geography at the University of Minnesota.

CYRIL BATHO, D.Sc., associate professor of applied mechanics and hydraulics at McGill University, has been appointed professor of civil engineering at Birmingham University in place of Professor F. C. Lea, D.Sc., who has resigned.

PROFESSOR SYDNEY CHAPMAN, professor of mathematics and natural philosophy in the University of Manchester, has accepted the invitation of the governing body of the Imperial College of Science and Technology to undertake the chief professorship of mathematics, beginning in September, in succession to Professor A. N. Whitehead, who has been appointed to the chair of philosophy at Harvard University.

DISCUSSION AND CORRESPONDENCE

CORROSION OF POLISHED METAL SURFACES BY ULTRA VIOLET RADIATION

IN previous investigations of the reflecting power of metals no mention is made of the corrosion of polished surfaces by the action of ultra violet radiation which seems to accelerate atmospheric corrosion.

In the course of an investigation of the ultra violet reflecting power of metals and of sulphides having a high metallic lustre Mr. C. W. Hughes and I have observed that portions of the surface which are exposed to ultra violet light become tarnished, while the unexposed parts remain bright. This corrosion is best perceived by breathing lightly upon the surface. Its effect is to perceptibly lower the reflecting power in the spectral region of wave lengths less than 350 μ.

W. W. COBLENTZ

LOWELL OBSERVATORY

A QUESTION OF CLASSIFICATION

IN view of the extremely up-to-date attitude of the geneticists, cytologists and taxonomists, whose conclusions are changing almost from day to day, it is extraordinary to note how excessively conservative they seem to be when dealing with the larger questions of plant classification. In many current textbooks the same primary divisions, or sub-kingdoms, are accepted that were in vogue more than half a century ago. One is inclined to ask whether this is the result of ignorance or merely of indifference.

While it is true that a separation of the plant kingdom into properly coordinated primary divisions is by no means a simple matter, it is rather depressing to find, even in the latest texts,[1] excellent in many respects, no effort at the presentation of a classification more in keeping with our present knowledge of plant relationships. To find that great omnium gatherum of unrelated plant-groups, the

[1] For example, Sinnott's "Botany, Principles and Problems," recently reviewed in SCIENCE.

thallophytes, accepted as a single primary division or sub-kingdom, while the undoubtedly homogeneous group of embryophytes—the Archegoniates and seed-plants—is split into three sub-kingdoms, each presumably coordinate with the whole aggregation of thallophytes, makes one wonder by what process of reasoning the authors have perpetuated such an unscientific and outgrown system of classification.

It is generally agreed that comparative morphology, and especially the structure of the reproductive parts, is the safest clue to relationships upon which a scientific classification must rest. In the book referred to[2] the following passage occurs: "This group (Anthocerotales) has always been of particular interest. . . . as suggesting a possible connection between bryophytes and those higher plants (pteridophytes) in which the sporophyte is an independent individual." But a few pages further on (p. 325), the astonishing statement is made, "In passing from the bryophytes to the pteridophytes . . . we cross the widest gap which exists in the continuity of the plant-kingdom!"

How is the student to reconcile such an obvious contradiction, and how is the instructor to justify a system which teaches that a bacterium and a giant kelp are more closely related than a liverwort and a fern, although the two latter agree in the minute details of the essential structures of both their sexual and non-sexual reproduction? Either comparative morphology has no meaning, or the divorce of the two divisions of the archegoniates is absolutely unwarranted.

It would be very gratifying if some of the defenders of this, to the writer quite incomprehensible, view would explain *in detail* the reasons for the faith that is in them.

Stanford University

Douglas Houghton Campbell

CATALOGUE OF PUBLISHED BIBLIOGRAPHIES IN GEOLOGY 1896–1920[1]

The publication of this noteworthy catalogue of bibliographies as No. 36 of the bulletins of the National Research Council is a further extension of the council's efforts to supply bibliographic assistance to the research workers of the country. Previous bulletins have contained similar lists covering periodical bibliographies and abstracts, and the present issue is the first devoted to a single subject. Like the earlier publication the present volume is not a bibliography of geology, but simply a catalogue of published geological bibliographies. The project was undertaken for the Research Information Service and the Division of Geology and Geography, National Research Council, and it is hoped that the council is planning to issue similar catalogues for the other sciences.

The catalogue which Professor Mathews has prepared is practically a continuation of DeMargerie's classic *Catalogue des Bibliographies Géologiques*, issued under the auspices of the International Geological Congress in 1896, containing references to 1895. The present work covers the succeeding 25 year period and embraces 3,699 titles arranged alphabetically by subject. These are divided into three groups or categories, general, special and personal. The first group is made up of a list which deals with publications of interest to geologists, but no attempt has been made to include such works as "Révue Bibliographique Universelle," "Reader's Guide to Periodical Literature," and other bibliographical aids, well known to the librarians and bibliographers. In the second group, only one master entry with cross references has been made, and its choice has been determined by the major interest underlying the compilation of the bibliography. The motive has been to place the major entry where it would most probably be sought, and the cross references where they might be serviceable. The third group includes "Personal Bibliographies" and "Necrologies," with attached bibliographies of geologists, mineralogists and paleontologists. The format of the references, while lacking many details dear to the librarian, contains all that is essential to lead the research worker to the available material.

Although the catalogue may prove incomplete as an exhaustive list of foreign bibliographies, it seems to include practically everything dealing with American geological literature available to American geologists. It should save both time and possible oversight of existing information for those in geological research. The National Research Council is to be commended for undertaking the program of preparing such helps for the research worker and also the compiler with his collaborator, Miss Grace E. Reed, for the thorough manner in which they have covered the literature scattered through a thousand serials.

James H. Hance

Urbana, Illinois

THE NET ENERGY CONCEPTION

In Science for April 18, 1924, Dr. E. B. Forbes quotes a paper read by him at a recent meeting of the American Society of Animal Production and a resolution passed unanimously by that society. The present writer dissents from a good deal that is con-

[2] Page 319.

[1] Compiled by Edward B. Mathews, National Research Council, Washington, 1923, 228 pages. Price, $2.50.

tained both in Dr. Forbes's paper and in the resolution; and, as it is a question of deciding on a system of units to be used in measuring the nutritive energy of farm feeds and of obtaining cooperation and support for a certain program of work for the Pennsylvania Institute of Animal Nutrition, he feels that some further discussion is justified.

The following statements seem to the writer particularly questionable:

(From Dr. Forbes's article)

The net-energy conception of Armsby is the simplest and most inclusive of all general measures of nutritive value. . . .

But net energy is the best possible standard for the expression of the most extensive nutritive requirement, and is, in this sense, the best possible single measure of food value generally.

(From the resolution)

These investigations (of Dr. Armsby) . . . have furnished the most accurate quantitative measure of the productive value of different feeding stuffs. . . .

The society endorses the Armsby conception of net-energy values derived from his researches with the respiration calorimeter.

The subject of the energy values of foods is a complicated one. Further articles on it from this laboratory have already been prepared for publication, and further experimental work has already been started. But certain important aspects of the situation may be briefly outlined here.

In Armsby's calorimetric experiments the quantities of heat given out by an animal are compared in two different periods, in which it receives different amounts of a given food. The extra heat given out in the period in which the larger amount of food is consumed is taken as the energy expended in the consumption of the extra food given in that period, and the net energy of the food in question is found by subtracting the energy expended in its consumption as above determined from its total metabolizable energy.

A study of Armsby's work makes it quite clear that a considerable part of the "energy expended in food consumption" in his experiments is expended through increased muscular activity of the animals during the periods in which they receive the larger amounts of food. All energy lost through muscular activity, therefore, is counted as waste in Armsby's system; and it is clear that the net-energy values are not a general measure of the nutritive energy of foods, but at best a measure of the nutritive energy for the special purposes of maintenance and fattening. Other physiological considerations make it questionable whether the net-energy values can be accepted as a measure of the relative values of different foods under practical conditions even for the purposes of maintenance and fattening.

The muscular activity of animals is under the control of the central nervous system, and it is doubtful, therefore, whether its extent under different conditions will be subject to any simple mathematical law. In Armsby's experiments muscular activity is a considerable factor in the energy expended in the consumption of the feeds used by him. If his figures for net energy are to hold good under practical conditions, therefore, it must be assumed not only that the muscular activity stimulated by a given food will be proportional to the quantity of food given, but also that the relative amounts of muscular activity stimulated by different foods under practical conditions will be the same as under the very unusual conditions which obtain in the calorimetric experiments. To the writer both of these assumptions seem highly improbable; and he feels that for this and other reasons it is still far from settled whether figures obtained in such calorimetric experiments as those of Armsby will be of value in comparing different foods for practical use. These experiments have been carried on for about twenty years now, and an extensive table of net-energy values has been published. It is desirable that at this point in the progress of the science of nutrition the net-energy values already in existence should be thoroughly tested out in long-continued practical experiments to determine whether they are a better index of the values of foods for the maintenance and fattening of cattle than are the total digestible nutrients which have been used in the past.

Edward B. Meigs
Bureau of Animal Industry,
U. S. Department of Agriculture

SCIENTIFIC BOOKS

The Cactaceae, Descriptions and Illustrations of Plants of the Cactus Family. By N. L. Britton and J. N. Rose. The Carnegie Institution of Washington. Vol. I, 1919; Vol. II, 1920; Vol. III, 1922; Vol. IV, 1924.

The Cactaceae, an exclusively American family of plants of wide geographical range and of varied economic importance, has long needed a thorough revision. Several attempts had been made before, chiefly in Europe, where these plants always were favorites and where quite a special literature treats of their cultivation.

We are therefore much indebted to the Carnegie Institution of Washington for having taken up this matter, at the recommendation of Dr. D. T. MacDougal, in 1912, and to the authors, Drs. Britton and Rose, for their comprehensive monograph.

The authors began their work about 20 years ago. They carefully examined the previous literature, went to Europe to look up the types preserved in the great herbaria or still in cultivation in the collections of public and private botanic gardens, and besides visited and collected cacti in almost every country in the Americas. Thus the authors brought together a most complete collection of herbarium specimens, photographs and drawings as a basis for their work. These large and unique collections are preserved at the Smithsonian Institution in Washington and at the New York Botanical Garden, to which institutions every future student will have to turn. The amount of work involved in this study can hardly be overestimated, but to every student of this family the difficulties which were to be overcome are at least partly known.

The whole monograph consists of four large quarto volumes, beautifully printed and freely illustrated with drawings and photographs in the text and with excellent plates, most of them from colored drawings of Miss Mary E. Eaton, the able artist of the New York Botanical Garden. These plates, besides being most useful to the student, add a great deal of charm to the books and give to the uninitiated at a glance an idea of the wealth of forms and colors of the cactus family.

The whole work describes 1,235 species under 124 genera. Most of these genera have been revived or are newly proposed by the authors. I see in these many newly created genera, the greatest progress made in our knowledge of these plants. They all form well circumscribed and natural groups and convey to us a precise picture of the development or the evolution of these strange plants, which was completely obscured under the old 20 to 24 collective and arbitrary genera of the older monographs.

In looking through these four volumes we are gratified to see the painstaking care of the authors to do justice to their fellow-workers and the enormous amount of new facts and data, which will make this the standard reference work for generations to come. A complete index of the four volumes, carefully compiled by Miss Rebecca Rose, adds to the value of the work for its ready use.

It is to be hoped that the efforts of both the Carnegie Institution and the authors will find ample reward in the increased interest of botanists as well as of the general public in this marvellous entirely American family of plants. The work is purely systematic, but it suggests on every page any number of biological problems which are still to be solved and which will prove the cacti to be one of the most promising fields for investigation.

It is impossible here to enter into detail, tempting as it may be. We must leave that to the reader himself. The authors deserve great credit for their work and the Carnegie Institution is to be congratulated on having presented such an elegant series of volumes to the students and lovers of plants.

ALWIN BERGER

NEW YORK AGRICULTURAL
EXPERIMENT STATION

LABORATORY APPARATUS AND METHODS

A SHORTER CELLOIDIN METHOD

THE celloidin method of embedding has never enjoyed the popularity of the paraffin method among botanists, and some laboratories have now abandoned it or employ it only when the desired results can not be obtained by other means. This antagonistic attitude has undoubtedly arisen because of the length of the process, the need of a long series of celloidin solutions, and the application of heat, which is detrimental to delicate tissues, for long periods of time. These objections have been surmounted in a shortened process now employed in this laboratory wherein air pressure is used and only two celloidin solutions are needed.

The pressure tank, which can be manufactured by a millwright for a nominal sum, is made from a piece of iron pipe six inches in diameter and one foot in length with the lower end closed by a cap and the upper bearing a flange two inches wide and about one inch in thickness. A cast iron cover, the diameter of which equals that of the flange, is fitted with an automobile tire valve to permit the introduction and release of air. This cover is ground smooth on the lower surface and by means of eight bolts can be drawn tightly down on to a rubber gasket laid over the flange. Approximately 30 two-ounce bottles can be placed in a tank of this size, providing pieces of wire gauze are inserted between the layers.

The material to be embedded is covered with two per cent. celloidin in uncorked bottles, placed in the tank, and subjected to an air pressure of approximately 100 pounds per square inch for 30 minutes. Slightly lower pressures have been used with good results, but it has been impossible to obtain much higher pressures with a hand-operated tire pump. After the half-hour interval the pressure is slowly released through the valve, the material transferred to 16 per cent. celloidin and the process repeated. A few shreds of celloidin will then serve to thicken the matrix at room temperature, and hardening in chloroform may take place the following day.

To date this method has been used on only two types of material. Dormant buds of trees and woody plants showed an imperfect penetration, nevertheless the infiltration was much better than that obtained by the older method. Cambial material of woody plants, together with the adjacent phloem and xylem, showed excellent penetration with no distortion of the delicate tissues, and cuttings taken in both the resting

and active seasons gave equally acceptable results.

In presenting this note it is the hope of the author that other workers will find it adaptable to their needs.

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SPECIAL ARTICLES

ON THE SIMULTANEOUS DIURNAL VARIATION OF THE ELECTRIC POTENTIAL OF THE EARTH AND THE AIR

IT has been known for more than a century that there is both an annual and a diurnal variation of the electric potential gradient of the air, but there is, as yet, no consensus of opinion among physicists as to the cause of these variations or even of the potential gradient itself.

The fundamental fact is that the earth is surrounded by an electrostatic field, so that if an elongated, insulated conductor be placed vertical anywhere over the surface of the earth it will regularly be found to have a negative charge at its upper end and a positive charge at its lower end. Such a condition can be maintained in a conductor only by the induction of a charge upon some other body. That this condition is maintained in the conductor mentioned above by a negative charge upon the earth or by a positive charge above the earth was plainly shown by Erman, in 1803, and by Peltier, in 1836. Peltier devised an apparatus for determining the potential gradient over the earth which was based upon the laws of electrostatic induction. This potential gradient has come to be called the potential gradient of the atmosphere, since it is measured in the atmosphere and was originally believed to be due to positive electric charges in the atmosphere.

Both Erman and Peltier believed the inducing charge to be upon the earth, and this opinion has been held by many physicists since that time; but others have believed it to be due to positive electric charges in the air or to a positively charged conducting layer in the upper air.

That the latter assumption can not be the true explanation follows from the fact that there is no potential gradient inside a charged hollow conductor due to a charge upon this conductor. Neither can a potential gradient be induced inside a hollow conductor by a charge outside the conductor. It accordingly follows that if the earth is surrounded by a good conducting layer in the upper atmosphere, the only possible potential gradient around the earth must result from its own charge or a charge upon its lower atmosphere.

In SCIENCE of May 25, 1923, the present writer undertook to show that the yearly variation in atmospheric potential gradient is such as would be expected to result upon a negatively electrified earth under the inductive influence of a similarly electrified sun. This paper is intended to show that the same may be said of the diurnal variation.

The writer has shown in various papers[1] that the day side of the earth is regularly electropositive to the night side. It is well known that the atmospheric potential gradient is regularly greater upon the night side of the earth than upon the day side, as it would be if it were due to the induction of the earth's negative charge.

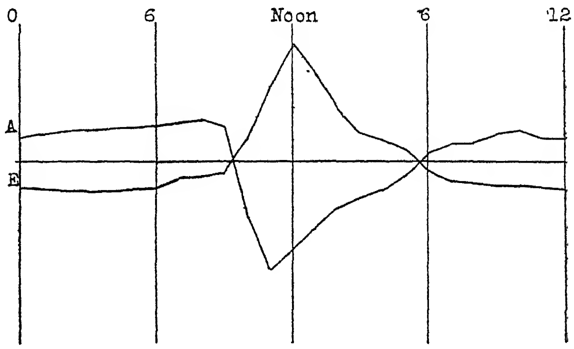

FIG. 1. Diurnal variation of earth potential and of air potential gradient for the months September, 1923–January, 1924. Curve A represents the variation of the air potential gradient and curve E the variation of earth potential.

Since last September, continuous photographic records have been kept of the diurnal changes in both the electrical potential of the earth and of the air. On February 1, the electrometer which was used for measuring the atmospheric potential gradient was moved and its sensitivity was changed, so the present report covers the time from September 1 to February 1. During that time there were occasions when the atmospheric potential gradient was greatly disturbed by storms, and otherwise, but measurable records were obtained for 87 days. All these were used in determining the mean diurnal variation for the period. During the same time 135 measurable records of the earth potential variation were obtained.

The mean values of the two diurnal variations in scale readings are shown in figure 1. Curve E represents the mean diurnal variation of the earth potential and Curve A the mean diurnal variation of the atmospheric potential gradient.

The agreement of these curves with theory is certainly very satisfactory. Since February the two electrometers used in the investigation have been

[1] See, especially, Bulletin of the Terrestrial Electric Observatory of Fernando Sanford, Palo Alto, California, Vol. 1.

placed in the same cage and their deflections are recorded upon the same sheet, and the agreement is, if possible, better than before.

Fernando Sanford

Palo Alto, California

THE AMERICAN CHEMICAL SOCIETY

Division of Biological Chemistry

W. T. Bovie, *chairman*

R. A. Dutcher, *secretary*

Studies of the vitamin potency of cod liver oils—X. Vitamin potency of medicinal cod liver oils: Arthur D. Holmes. In order to obtain information concerning the vitamin potency of present-day medicinal cod liver oils, a number of bottles of oil were purchased on the open market. The chemical and physical characteristics of these oils were determined by the usual analytical methods. A study of their vitamin potency showed that the vitamin content of medicinal cod liver oils may vary as much as tenfold. Also, it appears that there is little, if any, relationship between the chemical and physical characteristics of cod liver oils and their vitamin potency. These results show the need of information concerning the amount of the fat-soluble vitamins present in cod liver oil to be used in vitamin therapy.

Studies of the vitamin potency of cod liver oils—XI. The vitamin potency of butter oils produced on summer feeds. Arthur D. Holmes. To obtain information concerning the vitamin potency of dairy butter, a supply of milk was obtained from several cows. These cows represented a number of well-known dairy breeds, but they were of different ages, and their pasture diet had been supplemented by different commercial grain rations. For the purpose of this study, the milk fat was separated in the form of butter oil. The vitamin potency of the different butter oils was determined under uniform laboratory conditions. The results of these tests indicate that summer butter produced under favorable conditions may have a vitamin potency equal to one hundredth that of first quality cod liver oils.

Detoxication of aromatic cyanides: C. P. Sherwin and L. R. Cerecedo. Giacosa fed benzyl cyanide to dogs and found an increase in the ethereal sulfate excretion and also a positive reaction with Millon's reagent. He claims to have isolated phenaceturic acid from the urine. We fed benzyl cyanide to dogs and found neither phenaceturic nor hippuric, but free benzoic acid in the urine. After feeding p-chlorbenzyl cyanide to dogs, we noticed no symptoms indicating marked toxicity. We found only p-chlor-benzoic but neither p-chlor-phenaceturic or hippuric acid. We are studying the effects of this compound in the metabolism of the dog.

A method for the estimation of hydrogen sulfide in food products: L. H. Almy. Hydrogen sulfide is driven out by a current of carbon dioxide bubbling through the aqueous acidified mixture of the food product. It is absorbed in dilute zinc acetate solution, the latter solution then being treated with p-amino-dimethylaniline hydrochloride, hydrochloric acid and ferric chloride solution for the production of the methylene blue color. The amount of sulfide sulfur present is determined by comparison of the color with that of standards prepared by treatment of solutions containing known amounts of sulfide sulfur with the aforementioned test reagents. Analyses of beef, pork and fish showed that hydrogen sulfide was formed progressively during the putrefaction of these products. The method is also applicable to the examination of mineral waters, sewage, bacterial cultures, etc.

The isolation of a crystalline substance (M. P. 223° C.) from autolysed yeast with the properties of a bios: Walter H. Eddy, Ralph W. Kerr and R. R. Williams. A crystalline substance with a melting point of 223° C. will be exhibited, which by crystallographic methods has been shown to be a single substance and which when added to Fulmer's Medium F. in quantity not exceeding .005 mgs per cc of culture medium increases the volume of yeast cells in a 24-hour incubation at 31° C. by approximately 15 to 20 times that of a control on the medium alone. The method of obtaining this crystalline bios through use of differential adsorbents and pH control will be outlined.

A colorimetric method for the determination of furfural: Guy E. Youngburg and George W. Pucher.

The vitamin A content of fresh eggs: Joseph C. Murphy and D. Breese Jones. Experiments indicate that rats which have been permitted to develop xerophthalmia on a Vitamin A free basal diet can be cured of xerophthalmia, and restored to normal weight by feeding 0.75 gm of fresh whole egg daily. Smaller amounts are sufficient for curing xerophthalmia than for restoring of growth. 0.25 gm fed daily, after onset of xerophthalmia, sufficed to cure the eye condition, without, however, permitting restoration to normal weight and growth. Based on analyses previously reported, 0.75 gm and 0.25 gm of whole egg are equivalent, respectively, to about 0.25 gm and .088 gm of yolk. On the basis of dried yolk, these figures would be 0.13 and 0.41 gm. Expressed in terms of the oil content of egg yolk, about 75 mgm of egg oil would be required for growth restoration, and 25 mgm for curing xerophthalmia.

Determination of the protopectin in Irish potatoes: C. M. Conrad. In attempting to work out a reliable method for the determination of protopectin in potatoes, the concentration of acid, the pressure and the period of heating have been systematically varied and the resulting pectin determined by the calcium pectate method of Carre and Haynes. The results show that each of these factors has a very important effect. The highest yield of calcium pectate was obtained by boiling the material at atmospheric pressure for one hour in one thirtieth to one fiftieth normal hydrochloric acid. When the other conditions were optimum, a higher pressure did not increase the amount of pectin liberated.

The equilibrium between creatine and creatinine in aqueous solution and the effects of hydrogen ion: Graham Edgar and H. E. Shiver. The equilibrium con-

stant for the conversion of creatine to creatinine in aqueous solution has been determined at 25°, 50°, 70° and 100° C. The heat of reaction is about 4,800 cal. The effect of increasing hydrogen ion concentration is to increase the ratio of creatinine to creatine because of the formation of a larger proportion of creatinine ion than of creatine ion. Measurements have been made of the equilibrium conditions in solutions of known pH, and the theoretical relations have been discussed.

The buffer mechanism for the calcion concentration: I. Newton Kugelmass. The calcion concentration is regulated by calcion buffers. They are electrolytes which resist the change in calcion concentration upon addition of calcium salts. Calcion buffers are mixtures of weak acids, HA, and their salts, BA, which react to form normal calcium salts and soluble intermediate calcium salts. The calcion concentration of any calcion buffering solution is given by

$$Ca^{++} = K \div \frac{[HA]^n}{[BA]^{2n}}$$

where n is the ratio of the valence of calcium to that of the acid, and K is an equilibrium constant. Expressed in logarithmic units,

$$\log \frac{1}{[Ca^{++}]} = pK\,pCa$$

and

$$pCa = pK + n \log \frac{[BA]^2}{[HA]}$$

The determination of calcion buffer values: I. Newton Kugelmass.

The estimation of hydrogen ion concentration by colorimetric titration: J. C. Blake. Neutral water, to which has been added the same concentration of neutral indicator as added to unknown, is titrated with dilute (0.01 normal?) acid or alkali until colors match to the eye. Final adjustment is made by further titration in colorimeter vessels, or by motion of plungers. By increasing volume of neutral water started with, any degree of accuracy can be obtained. Colored solutions (for example, urine) yield satisfactory results, provided the color of entire column of liquid is first matched against Lovibond glass slides, which are likewise used in the final titration. The slides also permit establishment of the neutral point for various indicators in terms of unchanging colors.

A factor influencing reproduction and nursing of the young in the albino rat: Chas. H. Hunt. Rats reared on a synthetic diet of purified protein, fat, carbohydrates, salt mixture and vitamins A and B grew at normal rate but were sterile. With this diet and 10 cc milk they were sterile. With this diet minus the salt mixture and 10 cc milk, they were fertile and reared young. With $CaCl_2$ and Na_2HPO_4 added (separately) to the milk, they reared four generations. If the $CaCl_2$ and Na_2HPO_4 were mixed and added to the diet, instead of to the milk, the rats were fertile, but not very successful in rearing young.

Notes concerning the effects of radiation on solutions of albumen: W. T. Bovie and O. C. Woolpert. One volume of egg white was diluted with nine volumes of either distilled water or physiological salt solution and exposed to the radiations of a powerful mercury vapor arc. Before radiation the solutions were adjusted to various hydrogen ion concentrations by the addition of dilute acetic acid or sodium hydroxide and the effect of the hydrogen ion concentration on the heat coagulability of the radiated solutions determined. The hydrogen ion zone of heat coagulation is greatly constricted by radiation. The constriction proceeds, it seems, only from the alkaline side. These results are not in agreement with results previously reported by other investigators.

On the mechanism of the light action on solutions of albumen: W. T. Bovie and O. C. Woolpert. Egg white solutions made up as above with hydrogen ion concentration adjusted for optimum heat coagulation were exposed to a powerful mercury vapor arc at 15°. Coagulum appeared immediately and increased during an exposure of fifteen hours when all the albumen was precipitated. Ten cc portions of a solution of albumen that had been radiated for two hours were removed and heated for half hour periods at temperatures ranging from 25° to 75° C. Each increment of temperature resulted in an increment in the amount of coagulum. Therefore, a radiated albumen solution contains not only molecules which will coagulate at 15° but other molecules which require higher temperatures to produce coagulation.

A micro method for total nitrogen: A. R. Rose.

The inhibition of coagulation in albumen solutions produced by radiation: W. T. Bovie and O. C. Woolpert. Solutions of egg albumen with the hydrogen ion concentration adjusted to the alkaline side of the iso-electric point (5×10^{-7}) at which they may be completely coagulated by heat if radiated for a sufficient period of time do not coagulate upon heating to 100° C. The inhibitory effect of the light was also shown by alcohol experiments. The increased stability of the radiated solutions can be more strikingly demonstrated by mixing a small amount of the radiated solution with a large amount of non-radiated solution, when it will be found that the mixture will not coagulate even though heated to 100°.

Reactions of cysteine, cystine and glutathione: M. X. Sullivan. When 5 cc of solutions of various amino acids and thio compounds are treated with 1 cc of a 0.5 per cent. solution of 1.2 naphthoquinone-4-sodium sulphonate and then with 5 cc of a 20 per cent. solution of sodium sulphite in N/4 NaOH, the cysteine (used as hydrochloride) alone gives a red color. Glutathione, both in the oxidized and reduced form, failed to give the reaction. Cystine gave the reaction slowly, due to the reduction to cysteine by the sulphite. When the solutions of amino acids and of various thio compounds are treated with the naphthoquinone and then with one tenth volume of normal NaOH there speedily develops a color varying from reddish orange to dark brown, dependent on the concentration of the amino acids. Of the colors thus formed that given by cysteine is the only one not reduced to yellowish by sodium hydrosulphite $Na_2S_2O_4$.

SCIENCE

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CONTENTS

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SOME CONDITIONS FOR EFFECTIVE RESEARCH[1]

The first requisite for effective research has to do with the make-up of the research worker. Although it is outside the province of this paper to enter into an exhaustive discussion of the qualifications of a scientist, it is pertinent to point out some of the most essential characteristics. Training, intellectual power, physical fitness, application and integrity are requirements which need no explanation. Stability is a trait which is often given too little weight. Some of the ablest men are affected with a restlessness which impairs their usefulness. We need investigators who will devote a lifetime, if necessary, to a single problem instead of pursuing the latest scientific fad. In research, as in other fields, he who would succeed must be able to stand up under the strain of criticism, disappointment and failure. It is well to get away from the notion that the research man must be a genius or an abnormal type. With occasional exceptions he is merely an average person whose training and experience have fitted him for research and perhaps rendered him unfit for other vocations.

Assuming that we have the right type of investigators, what is needed to make their efforts most productive? The time was when the research worker's equipment consisted almost solely of an inquisitive frame of mind. This is still a primary requisite, but this alone is not enough. We are in an era of experimental research where facts count for more than logic. The world is no longer satisfied with general laws and principles. There is a call for specific information on thousands of subjects ranging from the education of children to the prediction of weather. Modern research requires modern facilities. This may mean laboratories fitted with expensive instruments, or it may mean comparatively limited apparatus but abundant facilities for travel and transportation. Research is as dependent upon equipment as is the modern factory.

The volume of work is so great that only a small part of it can be performed by investigators of first magnitude. This situation can be met by delegating work of a routine character to assistants who are trained to perform such duties but who for one reason or another are not qualified for independent research. Where a large number of instrumental

[1] Read at the fifth annual meeting of the Southwestern Division of the American Association for the Advancement of Science, El Paso, Texas, May 5 to 7, 1924.

readings is required, these can often be made as well by an apprentice as by a seasoned investigator. Draftsmen, accountants and typists can take a great load from the shoulders of the research worker. These well-known principles are not always practiced, with the result that research talent is wasted on relatively unimportant details.

Very often the investigator encounters problems which lead him outside the field in which he is trained. Studies of plant life, for instance, call for a knowledge not only of plants but of physics, chemistry, meteorology, geology and soils, not to mention the many phases of biology. Since the capacity of one individual to master various branches of science is limited, the logical solution is to obtain the assistance of specialists in the fields where he finds his own training deficient. Theoretically, the proper method of handling such problems is by a coordinated plan of attack involving specialists in the various lines concerned. In practice, such cooperation is difficult to secure because each worker usually finds his time more than taken up by his own problems.

All the foregoing suggestions point to the need for organized institutions for research where equipment, technical assistants and clerical help are provided and where the efforts of individual workers may be coordinated. There can be no doubt that such organizations promote efficiency. The one thing to be guarded against in any organization, however, is undue curtailment of individual freedom. This danger is especially great in state and government work, where appropriations are often made for specific projects or lines of work, and where the worker may be placed under pressure to make a quick showing of results. On the other hand, supervision and restrictions are often necessary to insure the direction of work along useful channels. Whether or not the advantages aimed at in organized research are realized depends very largely upon the directing head. In a large organization this head may be obliged to devote his time largely to administrative duties. He must be an administrator and at the same time a broad-gauge scientist—a combination which, unfortunately, is difficult to find.

By no means the smallest considerations are those affecting the living conditions, the home and social life of the workers. The research man is no longer a recluse who shuts himself up in a laboratory and whose thoughts are centered entirely on his own problems. He is made of the same clay and has much the same needs and desires as other human beings. If he lives a life of self-denial it is usually because of a small income rather than because of the exactions of his calling. He may be willing to make personal sacrifices for the sake of science, but he strives to give his family the advantages to which he feels that they are entitled. The opportunities for social life, recreation and contact with interests outside of his own profession afforded by adequate compensation will make of him a better scientist and a better citizen. If research does not offer such opportunities, it can not hope to attract men of ability.

Much depends upon the objects of research. But when we attempt to classify different kinds of research as to relative merit we immediately encounter difficulties. The discoveries which pass unnoticed to-day may acquire vast importance to-morrow. Investigations which aim directly at the solution of current problems command greatest attention from the public and even in the scientific world; yet every scientist knows that without the general store of knowledge accumulated by fundamental research the solution of current problems would be impossible. In the present age when utilitarian investigations are occupying the foreground we must look to our universities and institutions of a similar character to uphold fundamental research.

To make the most of his intellectual powers and opportunities every research worker should have a worthy incentive. Scientists take just pride in the feeling that their work is more to them than the means to a livelihood. To the true scientist the love of research is its own reward; but it is not an adequate reward. The thrill of discovery is a stimulus which quickens the pulse and brings forth temporary bursts of enthusiasm and energy, but it is not a sustaining force. Public appreciation and the esteem of fellow-workers has a strong appeal. The fact that positions of responsibility and distinction await those who can qualify for them is a spur to greater achievement. The greatest reward that can come to the research worker is to see the result of his labors applied in some line of human endeavor. In research, as in all other callings, service to mankind is the true measure of success.

Whatever may be the specific needs of research, their fulfillment is conditioned upon public approval. Whether research is supported by taxation or by private bequest, the public ultimately pays the bill. Those in whose power it lies to render material aid to research are usually not sentimentalists but business men, in the broader sense, who expect commensurate returns for every dollar expended. We must convince these people that research is a good investment. We must teach them to measure values by other standards than the dollar, but at the same time we must not ignore this standard. The medium through which the public can be most extensively reached is the press. Not all research problems lend themselves to popular treatment, but most subjects

can be presented in such form as to interest the more thoughtful and enlightened class of people. Needless to say, the aim of popular articles should be educational and should contain no suggestion of propaganda. Under certain conditions more can be done by personal contact than by writing. We should welcome every opportunity to explain our work to those who exhibit an interest in it. Above all, we should let it be known that we have definite objectives, and as far as possible point out what the attainment of these objectives will accomplish. It thus becomes the duty of research not only to discover new facts but also to disseminate and impress them upon the public conscience, for it is only when the public understands the value of research that it will be accorded the place it should occupy in our national life.

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A SUGGESTION FOR ABSTRACTS OF ANTHROPOLOGICAL LITERATURE

The informing idea of abstracts is that, as cut-shorts, they indicate the important knowledge printed in a specific article about a certain subject. By their perusal the reader may quickly know whether or not he desires to read the original article. An abstract is simply a short, impersonal analysis of a longer printed original. It does not criticize or comment.

Abstracts are of two main kinds: One is the so-called *author's abstract;* the other may be called the *collaborator's abstract.*

The author's abstract is prepared by the author. It may have two designations—depending on whether it appears with the article abstracted, or appears separately. The former is a "preliminary abstract" —being a short digest of the longer article which immediately follows it in the same volume. When the author's abstract appears separately it may be designated a "lifted abstract"—which, elsewhere, was a preliminary abstract but which has now been lifted from the place of its first printing and appears unaccompanied by the article of which it is the abstract.

The second of the main kinds of abstracts, the collaborator's abstract, is prepared by a collaborator and not by the author. It is unaccompanied by the original article. In other words, the collaborator's abstract is never a preliminary abstract; it is more nearly akin to the lifted abstract.

Both the author's abstracts and the collaborator's abstracts may have been, and probably ought to have been, under the blue pencil of an expert editor, but the work of the editor as such does not give name to the abstract.

Need for Abstracts

The need for abstracting the literature in a scientific field is inevitable at a certain advanced stage in the increasing amount of the published data in that field. No one who teaches a full-time schedule can read all he desires to read, or ought to read, in any live scientific field to-day. His available time is insufficient. All of us habitually lay aside for vacation reading certain excellent articles or books which come to our libraries in the busiest periods of the university year.

If we agree that this is the condition in anthropology, what is to be done in an attempt to meet the situation? We must note, in passing, that we are not going to publish fewer articles in anthropology, simply because constantly we are publishing more—as all other growing sciences are doing. There are two reasonable answers to our question: *One,* we can, of course, read our customary amount and "forget" the increasing amount which, like the waters, will go over us if we sit still. This, as we grow old, all of us may increasingly do; but it is an extremely difficult thing for a vital American thus to sit still and let the waters go over him. *Two,* we can get some one else to read for us much of the increasing volume of printed matter.

A few of the most productive American scholars have possessed private funds, or other sources equally as rare to American university professors, which have enabled them for years at a time to multiply, as it were, their brains, pens and typewriters, and they have thus been able to accumulate for personal use a vast fund of information. Thus a secretary and a staff of readers read virtually everything, excerpting or abstracting those parts which it is believed their employer desires. This glimpses the plutocratic stage of abstracting, possible for only a few men.

Present Status of Abstracting in United States

To-day the democratic stage of abstracting has dawned in a few fields for the use of all workers in those subjects. I quote the advertisement of a new abstract service to show how democratic and how inexpensive this service is in the field of sociology:

> The new abstract service offered by the American Sociological Society will provide subscribers with galley proof of the 100 abstracts each issue, 600 a year appearing in the *American Journal of Sociology,* of articles from the leading social-science periodicals in English, French, German, Italian, Scandinavian, and Spanish.

This service is to cost each subscribing member of the society one dollar per year. The following, ac-

cording to the advertisement, is what the member will receive for one dollar—non-members are to pay two dollars for the same service:

(1) Galley proof of these abstracts will be mailed before the publication date of each issue of the journal.
(2) The thin galley proof paper is adapted to satisfactory mounting on 3x5 cards. Any other form of abstract service, as by cards or slips, was found prohibitive in cost.
(3) The classification number at the end of each abstract will be found particularly helpful.

What else is for sale to-day in the American market which one can buy six for one cent? Again, we have an illustration of the cheapness in commodity production of those things democracy will buy many of, if the price is low enough. In other words, the democratic stage of abstracting is here—for a few natural and social sciences.

A partial, though nearly complete, list of scientific journals published in America which regularly carry preliminary abstracts with each of their articles would probably not exceed thirty. Among those journals best known to anthropologists are the following: *American Anatomical Memoirs; American Journal of Anatomy; Anatomical Record.*

If we step aside into the sociological field, and look at current numbers of the *American Journal of Sociology,* we see the best type of abstracting in any field near our own. I mean by the expression "best type" that each issue has both the preliminary abstract before each article it publishes, and also the lifted abstracts from other periodicals; and, in addition, and more important, it has also collaborator's abstracts of all noteworthy articles appearing in America and in Europe within the social-science field. These abstracts are also all printed in English, whereas abstracts printed by some other journals in America are lifted bodily and appear in the original language. However, the individual abstracts in the above periodical are not always of the best, largely because of the newness of abstract writing. But the objective has been visioned and the effort to reach it will undoubtedly bear better fruit in the near future when a standard has been set and accepted for the best type of scientific abstracts.

STATUS OF ABSTRACTS IN ANTHROPOLOGICAL JOURNALS[1]

STATUS OF ABSTRACTS IN ANTHROPOLOGICAL JOURNALS[1]

Types of abstracts: Prelim-inary	Lifted	Bibli-ography	Review	Name of Periodical
No abstracts				Akademija umiejetnosci, Cracow. Materyaly antropologiczno-archeologiczne i etnograficzne. irr.
		x		American Anthropological Association. Memoirs. Lancaster, Pa. irr.
			x	American Anthropologist. Lancaster, Pa. q.
	x	x	x	American Journal of Physical Anthropology. Washington, D. C.
No abstracts				American Museum of Natural History. Anthropological papers. New York. irr.
			x	Annals of Archaeology and Anthropology. Liverpool. q.
No abstracts				Anthropological Society of Bombay. Journal. Bombay. irr.
	x	x	x	Anthropologie—Published by the Anthropological Institute, Charles University of Prague. (In Czecho-Slovakia.)
		x		L'Anthropologie. Paris. bi-m.
			x	Anthropologische Gesellschaft in Wien. Mitteilungen. Wien. bi-m.
No abstracts				Anthropologischer Verein in Schleswig-Holstein. Mitteilungen. Kiel. irr.
		x	x	Anthropos. Internationale Zeitschrift für Völker- und Sprachenkunde. bi-a.
		x	x	Archiv für Anthropologie. Braunschweig. irr.
		x	x	Archiv für Kriminal-Anthropologie und Kriminalistik. Leipzig. irr.
		x	x	Archiv für Rassen- und Gesellschafts-Biologie. Munich.
	x	x	x	Archives d'anthropologie criminelle. Lyon. m.
			x	Archives suisses d'anthropologie générale. Genève. irr.
		x	x	Archivio di antropologia criminale. Torino. bi-m.
		x		Archivio per l'antropologia e la etnologia. Firenze. 4 nos. a year.

Status of Abstracts in Anthropological Journals[1]

Types of Abstracts: Preliminary	Lifted	Bibliography	Review	Name of Periodical
No abstracts				Beiträge zur Anthropologie und Urgeschichte Bayerns. München. q.
No abstracts				Columbia University Contributions to Anthropology. New York. irr.
No abstracts				Field Museum of Natural History. Publications: Anthropological series. Chicago. irr.
			x	International Journal of American Linguistics. New York City.
No abstracts				Institut français d'anthropologie. Comptes rendus des séances. Paris. irr.
			x	Journal of Negro History. Washington, D. C.
			x	Journal of Race Development. Worcester, Mass. q.
		x		Königliches zoologisches und anthropologisch- ethnographisches Museum zu Dresden. Abhandlungen und Berichte. Leipzig. irr.
		x	x	Man. London. m.
			x	Niederlausitzer Mitteilungen. Guben. irr.
		x		Philippine Islands—Bureau of Science. Philippine Journal of Science. Section D: General biology, ethnology and anthropology. Manila. bi-m.
	x		x	Politisch - anthropologische Monatsschrift. Berlin. m.
			x	Revue anthropologique. Paris. m.
x (summary)		x	x	Rivista di antropologia. Roma. 3 nos. a year.
		x	x	Royal Anthropological Institute of Great Britain and Ireland. Journal. London. bi-y.
	x	x	x	Russki anthropologicheski zhurnal. Moscow. q.
	x	x	x	Société d'anthropologie de Lyon. Bulletin. Lyon. y.
		x		Société d'anthropologie de Paris. Bulletins et mémoires. Paris. bi-m.
		x		Société dauphinoise d'ethnologie et d'anthropologie. Bulletin. Grenoble. q.
			x	University of Pennsylvania Museum. Anthropological publications. Philadelphia. irr.
			x	Ymer. Stockholm. q.
		x		Zeitschrift für Ethnologie. Berlin. bi-m.

Three Types of Genuine Abstracts Varying in Relative Completeness

The simplest type of abstract is the *title abstract.* Dr. J. R. Schramm, executive secretary of the division of biology and agriculture, National Research Council, has recently analyzed abstracts of all three types. In an unpublished paper he concludes that title abstracts present roughly 40 per cent. of the data appearing in the original article. Title abstracts are simply customary bibliographical entries. Those appended to research articles published in scientific periodicals illustrate this type; but data in original articles to the extent of 60 per cent. are unknown to the person who reads only title abstracts of articles.

The second type is the *partial abstract.* It carries, roughly, about 60 per cent. of the data appearing in the original article. Abstracts prepared today by most authors of anthropological papers would

[1] Under this heading everything has been listed which suggests the contents of a definite article. Even with all this generosity the showing is poor, indeed. "Bibliography" covers only title abstracts. A "Review" today is often not an abstract at all. Too often reviews are only smart remarks which the publication gave the reviewer occasion to utter.

The check mark (x), preceding the name of each periodical, designates the type of so-called abstract appearing more or less regularly in that periodical.

The list of periodicals includes only those available in one or the other of the following libraries: Surgeon General's Office and Bureau of American Ethnology in Washington, D. C., and N. Y. Public Library in New York City.

probably be of this type—preceding instruction in preparation of a better type. Thus 40 per cent. of the data in the original article is unknown to the reader who has access to only the partial abstract.

The third type is the *complete abstract*. It carries 100 per cent. of the data or entities of the original article. The complete abstract prepared to meet definite standards occupies between 4 per cent. and 5 per cent. of the space of the original article—as scientific articles are now commonly printed. However, a complete abstract does away entirely with the need of a summary at the close of the original article. So, if articles are written with the certainty that they are to be abstracted, they no longer need to carry summaries. Therefore, the printing of a complete preliminary abstract, in addition to the original article, minus its usual summary, need add very little, if any, to the space required for printing the original article with its customary summary.

The standard Dr. Schramm sets for complete abstracts is that every entity appearing in the original article will appear, in its proper sequence, in the complete abstract, and that it will appear in at least one complete sentence; frequently it will have more than one sentence. Some one has urged that only new data should appear in the abstract, but this is not enough. Each entity in the original, whether or not new, must appear in the abstract, if it is to be complete.

Further, the standard, scientific complete abstract thus will carry every entity that should go into the index. In other words, the indexer may, and would, prepare his index entries directly from the abstract by the process, as it were, of abstracting the abstract. Thus, the index entries will show the very quintessence of the original article without consumption by the indexer of the much longer time consumed in digesting the longer original article.

Advantages to the Individual of Complete Abstracts

(1) They greatly add to our equipment of scientific knowledge by giving us a digest of many more articles than we can possibly read in the longer original.

(2) They save us much time which is now more or less wasted in reading original articles of no great importance to us, but whose titles suggest contents of real value to us.

(3) They save us considerable money, by cutting down our subscription list of those periodicals about which we debate at each time of annual subscription.

(4) They save us library space in book shelves, and filing cabinets for periodicals, separates and fugitive articles.

(5) They probably will assist most of us in tending to develop a technique, even habits, of more logical analysis in our writings, and greater clearness in our presentations. On the certainty that we or collaborators must abstract the article, more logic will almost necessarily go into its preparation.

(6) They will save greatly in editorial work in the preparation of index entries for the volumes composed of the several current periodicals with abstracted articles.

Albert Ernest Jenks,
Chairman, Division of Anthropology and Psychology
The National Research Council

SCIENTIFIC EVENTS

RESEARCH BUREAU OF METALLURGY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY

As a further step in the plan to expand its scientific research facilities, announcement is made by the Carnegie Institute of Technology in Pittsburgh of the establishment of a special Research Bureau of Metallurgy to begin its work the first of September, 1924. The object of the new department is to apply to metallurgical questions the recent discoveries in the field of physics and chemistry. The organizing of this new bureau is the second important development concerning metallurgical research that has been reported during the year at the Pittsburgh institution. The first step, as was previously announced, was the adoption of a definite program of investigations in metallurgy to be made by the department of metallurgy at the institute in cooperation with the U. S. Bureau of Mines. Several college graduates have already been appointed to fellowships by the institute authorities to carry out the program of research problems, the investigators to have the financial aid and assistance of an advisory board of metallurgical engineers and steel manufacturers of Pittsburgh in addition to the cooperation of the Bureau of Mines. The new research bureau of metallurgy just organized will be a department established separately from the research investigations carried out by the department of metallurgical and mining engineering in cooperation with the Bureau of Mines. Dr. Francis M. Walters, Jr., has been appointed director and Dr. Vsevolod N. Krivobok has been appointed as an assistant. The appointment of another assistant, a specialist in X-ray work, will be made during the summer months.

As director of the bureau, Dr. Walters will also have the title of professor of experimental physics.

For the past two years he has been connected with the U. S. Bureau of Standards in Washington, D. C., as associate physicist. The members of the new bureau will devote their time almost exclusively to research. At first the work will be entirely of a theoretical nature, but it is expected that as progress is made the study of a certain number of practical questions will be undertaken.

ZOOLOGICAL FIELD LABORATORY OF THE UNIVERSITY OF KENTUCKY

THE University of Kentucky announces the establishment of a Zoological Field Laboratory near Quicksand in Breathitt County, Kentucky, which will be opened to students in the summer of 1925, as a part of the development of the recently acquired Robinson Mountain Lands.

The field laboratory consists of about five hundred acres of typical mountain country which shows almost perfect primeval conditions in native fauna and flora. It is extremely rugged, well timbered and watered, with attractive topographical features and unusual biologic resources. It is very rich in the number of species of insects, snakes, birds and mammals represented. Several mountain streams flow into the Kentucky River and Quicksand Creek on two sides of the laboratory so that exceptional facilities are offered for the study of aquatic life. The property includes some of the most picturesque of Kentucky mountain scenery. Suitable buildings and equipments will be provided for field laboratory work.

Through the courtesy of the College of Agriculture, students at the Field Laboratory will have the privilege of doing collecting, exploring and research over nearly fifteen thousand acres of closely adjacent mountain land in Breathitt, Perry and Knott Counties, including some of the roughest and least inhabited portions of the state. Part of the field laboratory will be set aside as a bird sanctuary.

The Zoological Field Laboratory will offer opportunity for research work in ornithology, entomology, herpetology and ecology at all seasons of the year, and for regular class instruction during the summer session. It will be under the direction of Dr. W. D. Funkhouser and Dr. W. R. Allen, of the department of zoology of the University of Kentucky.

CONFERENCE ON THE INGREDIENTS OF BACTERIOLOGICAL MEDIA

ON May 19, 1924, a conference was called at the Hotel Astor, New York City, to discuss the steps necessary in order to secure standardization of the raw materials of bacteriological media, such as peptones, agar, gelatin and so forth. The conference was called by the Society of American Bacteriologists through its committee on bacteriological technic; but representatives of various other organizations were invited. Those represented were: American Chemical Society, American Public Health Association, American Water Works Association, Dairy Science Association, the Dairy Inspectors' Association, the Society of American Bacteriologists, also two of the large public health laboratories, namely, the Hygienic Laboratory of the U. S. Public Health Service, and the Research Laboratories of the N. Y. City Board of Health.

The meeting was called to order by the chairman of the committee on bacteriological technic of the Society of American Bacteriologists who, by general consent, took the chair. He pointed out briefly the need of standardization in the field to be considered by the conference, but showed that much investigation would have to precede such standardization, and that this investigation would require the cooperation of all the organizations represented. The need of such cooperation was agreed to by all; but before taking up the means for bringing it about, considerable time was spent discussing the particular problems likely to be encountered in the work.

It was pointed out that the chief ingredients of culture media are: peptone, sugars, agar and gelatin. The need of standardization of sugars was recognized, but on account of the complexity of the problem and its smaller degree of urgency than in the case of some of the related problems, it was decided not to consider sugars at the present time, but to recognize them as a possible subject for similar investigation in the future. It was also pointed out that the problems in the case of agar and gelatin were likely to be fairly simple. For these reasons it was decided to give chief attention at present to peptone.

The various uses of peptone were considered: as a basis of media for the cultivation of miscellaneous bacteria; as the most important ingredient of the media used in counting water bacteria, and also milk bacteria; as one of the important constituents of media for studying fermentation; as the basis of the medium used in obtaining diphtheria toxin. It was suggested that each use might present a problem of its own and that it might be necessary to obtain a different type of peptone for each purpose; but it was generally hoped that one type might be found suitable for all purposes. It was decided that the only way to make progress would be to obtain various peptones of fairly definitely known composition and to learn which of them are best for which purposes by distributing them for testing among various bacteriologists. The matter of obtaining such batches of peptone was referred to the only manufacturer of

peptones present, a representative of Parke Davis and Co. He stated that his company kept a record of each batch of peptone made and would gladly furnish with each sample submitted the analysis of that batch as made in their laboratories. The opinion was expressed that the other manufacturers would probably be glad to do the same; but it was pointed out that different companies might make different kinds of analysis and it was suggested that one of the first tests of the contemplated investigation would be to standardize the type of analysis to which peptones should be submitted.

After discussing these various points to be investigated the matter of organizing the work was considered. It was the general opinion that so far as possible no new organization should be created, but that existing organizations should be used. It was pointed out that every organized body represented at the meeting had some committee dealing with the subject under discussion, and that a coordinating committee representing each of these individual committees would be sufficient to insure the needed cooperation. Accordingly the motion was made that a coordinating committee be appointed composed of the chairmen (or their representatives) of the various committees now in existence whose functions cover the matter of bacteriological media, this coordinating committee to put into operation a cooperative investigation looking toward the standardization of the ingredients of bacteriological media; and that the chairman of the committee on bacteriological technic of the Society of American Bacteriologists serve as chairman of the coordinating committee. This motion was seconded and carried by a unanimous vote.

PRELIMINARY ARRANGEMENTS FOR ATTENDING THE TORONTO MEETING OF THE BRITISH ASSOCIATION

PRELIMINARY programs of the approaching Toronto meeting of the British Association (which will occur from August 6 to August 13) have been sent to all members of the American Association residing in the United States. These were sent out from the Washington office of the American Association for the Advancement of Science, under authorization received from the council at the Cincinnati meeting. The American Association is omitting its summer meeting this year because of the Toronto meeting of its sister organization and the British Association has cordially invited all American scientists to be present. It is hoped that many members of the association will be able to attend the great international gathering of scientists and friends of scientific progress.

The following notes will interest persons planning to go to the Toronto meeting from the United States. Reduced railway rates, on the certificate plan, have been granted by the New England, Trunk Line, Central, Eastern Canadian and Western Canadian Passenger Associations. There will be advantageous round-trip excursion tickets available from regions not cared for by the special rates.

Persons intending to go to the meeting should consult their local railway agents, stating that they desire to attend the Toronto meeting of the British Association. If the special privilege is available from their station they should purchase a one-way, through ticket to Toronto and secure a certificate on the "standard certificate form." (A receipt is not needed.) On arrival in Toronto the certificate is to be presented in the reception room at the meeting. It will there be validated and *after validation* it will entitle the holder to purchase at the railway office a return ticket at one half the regular one-way rate.

If the special reduced rates are not available from your station you may purchase a round-trip ticket to some station from which you can secure the certificate privilege and then proceed as above. Or you may secure a round-trip to Toronto at excursion rates.

Persons traveling to Toronto on round-trip tickets to that place *should not neglect to report* this fact at the office in the reception room at the meeting, although there will be no certificates to be validated in such cases. Round-trip tickets are to be counted in making up the quota necessary for the special rates to those holding certificates.

We are informed that persons traveling to Toronto from the United States may have their baggage passed by the Canadian customs officers with little or no delay if they will state that they are going to attend the meeting of the British Association.

The honorary local secretaries for the Toronto meeting request that persons who plan to attend shall intimate this fact at the earliest possible time. Intimation blanks for this purpose were to accompany the preliminary programs sent to members of the American Association, but the shipment of blanks was delayed and it seemed best to send out the programs without them rather than to delay the sending until later, especially since the school and college year was about to close and many members might not have been reached if the sending had been further delayed. A supply of intimation blanks is available at the Washington office of the American Association and copies may be had on request. Intimation may be sent in without special blank, however. It should be addressed to the Honorary Local Secretaries, British Association, Room 50, Physics Building, University of Toronto, Toronto.

Intimation should include the name, titles and address of the sender. The fee for the meeting is $5 (transferable ticket, $6.50; student's ticket, $2.50—the latter for students not over 23 years of age, at

recognized educational institutions). A check, payable to the British Association for the Advancement of Science, should accompany the intimation to the honorary local secretaries, or payment may be made over the counter in the reception room at the meeting. The subsequently published report of the meeting may be subscribed for by those in attendance, at an additional price of $2.50. Members of the American Association in good standing may subscribe for the report without paying this additional fee, but they should clearly indicate their wish for it and claim this special privilege. Identification certificates for use in this connection have been placed in the hands of all members of the American Association who were in good standing at the time the preliminary programs were distributed from the Washington office.

The intimation blank requests information as to accommodations wanted at Toronto. A list of hotels and rates is shown in the preliminary program. *Hotel accommodations should be reserved immediately* if not already cared for; the hotels are apt to be crowded. Those desiring accommodations in the university or college residences or in a boarding house should intimate this to the honorary local secretaries.

It is asked also that persons planning to attend the Toronto meeting shall inform the honorary local secretaries in regard to their main scientific interests, so that the names of those planning to attend may be classified according to sections of the association. The sections of the British Association are as follows: A—Mathematics and Physics; B—Chemistry; C—Geology; D—Zoology; E—Geography; F—Economic Science and Statistics; G—Engineering; H—Anthropology; I—Physiology; J—Psychology; K—Botany; L—Educational Science; M—Agriculture.

BURTON E. LIVINGSTON,
Permanent Secretary, American Association for the Advancement of Science

THE TORONTO MEETING OF THE BRITISH ASSOCIATION

OVERSEA members of the British Association for the Advancement of Science coming to the Toronto meeting, beginning on August 6, include the following:

Section E—Geography

President—J. W. Gregory, professor of geology, University of Glasgow. His presidential address will deal with "The relation of white and colored races in reference to white colonization in the tropics."

Vice-president—Vaughan Cornish.

Recorder—R. N. Brown, University of Sheffield.

Secretary—W. H. Barker, professor of geography, University College, Southampton.

Frank Debenham, lecturer in geography in the University of Cambridge, was with Captain Scott in the Antarctic.

Miss R. M. Fleming, secretary of the Geographical Association.

Osbert John Radcliffe, secretary of the association, formerly geographical assistant to the editor of the "Encyclopaedia Britannica."

R. H. Kinvig, lecturer in the school of geography in the University of Liverpool.

Miss Marion Newbigin, editor of the *Scottish Geographical Magazine.*

John Hardwick Reynolds, assistant to the permanent committee on geographical names for the British Official Congress, the work of which is carried on at the Royal Geographical Society, London.

O. H. T. Rishbeth, lecturer in geography in University College, Southampton.

P. M. Roxby, professor of geography in the University of Liverpool.

A. Stevens, lecturer in geography in the University of Glasgow.

Alec Tweedie, traveler and writer on Iceland, Norway and Finland.

J. F. Unstead, professor of geography in the University of London.

Section H—Anthropology

President—F. C. Shrubsall, principal assistant medical officer, London County Council.

Vice-president—Charles E. Seligman, professor of ethnology in the University of London, president of the Royal Anthropological Institute.

Recorder—E. N. Fallaize, secretary of the Royal Anthropological Institute.

Secretary—Alexander Low, lecturer in embryology, Aberdeen.

Miss R. M. Fleming, secretary of the Geographical Association.

Dr. T. Ashley, director of the British School at Rome, who will speak on "Recent discoveries in Italy."

Henry Balfour, M.A., curator of the Pitt Rivers Museum, Oxford, will speak on "Anthropology and the administration of the affairs of native races."

Captain L. H. Dudley Buxton, University Museum, Oxford, will discuss "Ancient crania from the valley of Mexico," and will deliver one of the children's lectures at the meeting on "Beyond the great wall of China, and the people who live there."

A. C. Haddon, university reader in ethnology, Cambridge, will discuss "The distribution of early man."

R. R. Marett, dean of Exeter College, Oxford, will speak on "The cinematograph as an instrument of anthropology."

John Linton Myres, Wykeham professor of ancient history in the University of Oxford.

Harold J. E. Peak, ex-president of the anthropological section.

H. J. Rose, professor of latin in University College, Aberystwyth.

Section K—Botany

President—V. H. Blackman, professor of plant

physiology and pathology, Imperial College of Science, London. His presidential address will deal with "The physiological aspects of parasitism."

Vice-president—A. G. Tansley, lecturer in botany, University of Cambridge.

Recorder—F. T. Brooks, lecturer in botany, University of Cambridge.

Secretary—McLean J. Thompson, professor of botany, University of Liverpool.

Secretary—Wilfrid Robinson, lecturer in botany in the University of Manchester.

John William Bews, professor of botany, Natal University College, Pietermaritzburg, South Africa.

Miss K. B. Blackburn, lecturer in botany, Armstrong College, Newcastle-on-Tyne.

Sir J. C. Bose, founder and director of the Bose Research Institute, Calcutta.

H. H. Dixon, professor of botany, University of Dublin, director of Trinity College Botanic Garden.

H. S. Holden, lecturer in botany and zoology, University College, Nottingham.

Thomas Johnson, professor of botany in the Royal College of Science, Dublin; keeper of the botanical collections in the National Museum at Dublin.

J. H. Priestley, professor of botany, University of Leeds, will deliver one of the "children's lectures" at the meeting entitled "Plant waterproofs."

Alfred Barton Rendle, keeper of the department of botany in the British Museum.

Miss E. R. Saunders, Newnham College, Cambridge.

David Thoday, professor of botany, University College of North Wales, Bangor.

Miss Ethel N. Miles Thomas, head of the department of botany, University College, Leicester.

SCIENTIFIC NOTES AND NEWS

DR. F. W. MCNAIR, professor of physics and president of the Michigan College of Mines, was killed in a railroad wreck on June 30, while returning from the recent meeting of the Society for the Promotion of Engineering Education, of which he was at one time president. As previously recorded in SCIENCE, Dr. F. W. Ives, professor of engineering in the Ohio State University, died from injuries received in the same accident. Dr. John H. Dunlap, secretary of the American Society of Civil Engineers, was seriously injured.

AT the fourth International Conference of Soil Science, held in Rome, Italy, from May 11 to 20, it was voted to hold the next congress in the United States, probably in 1927. Dr. J. G. Lipman, dean of the college of agriculture and director of the experiment station at Rutgers University and the State University of New Jersey, was elected president of the next congress.

TRINITY COLLEGE, Dublin, has conferred the honorary degree of doctor of science on Dr. R. A. Millikan, of the California Institute of Technology, and on Professor E. B. Poulton, Hope professor of zoology in the University of Oxford.

THE University of Grenoble at a special ceremony held on June 5 conferred the degree of *Docteur honoris causa* on Professor Douglas Johnson, of Columbia University, exchange professor in engineering and applied science to the French Universities, and on Professor Albert Sauveur, of Harvard University. In connection with the ceremonies, a reception at the home of Recteur Guy, a banquet tendered by the University Council and an automobile excursion in the French Alps were arranged in honor of the recipients.

THE Royal Sanitary Institute has elected the following sanitarians to be honorary fellows: Professor Léon Bernard, Institute of Hygiene in Paris; Dr. Carlos Chagas, of the National Health Department, Brazil; Surgeon-General Hugh S. Cummings, U. S. A. Public Health Service; Professor C. Eijkman, Utrecht; Professor J. J. Van Loghem, Amsterdam; Professor Th. Madsen, director of the State Serum Institute, Copenhagen; Professor Donato Ottolenghi, of the University of Bologna; Dr. W. H. Park, bacteriologist to New York City; M. Albert Thomas, director of the International Labor Office, Geneva, and Mr. O. Velghe, of the Department of Hygiene in the Belgian Ministry of the Interior.

DR. JOHANNES SCHMIDT, director of the physiological department of the Carlsberg Laboratory, Copenhagen, has been elected a corresponding member of the French Academy of Sciences.

SIR NAPIER SHAW, professor of meteorology in the Imperial College of Science and Technology, London, formerly director of the Meteorological Office, has been elected a foreign member of the Royal Swedish Academy of Science in respect of his "masterly researches in the domain of meteorology."

PROFESSOR WILLIAM H. HOBBS, head of the geology department of the University of Michigan, has had conferred upon him the decoration of a Knight of the Legion of Honor by the French government.

PROFESSOR MAX RUBNER, formerly professor of physiology at the University of Berlin, celebrated his seventieth birthday on June 2.

DR. BARTON WARREN EVERMANN, director of the museum of the California Academy of Sciences and of the Steinhart Aquarium, sailed on the Matson Line Steamer *Maui* on July 23, for Honolulu, where he will attend the Food Conservation Congress to be held in Honolulu from July 31 to August 14, under the auspices of the Pan-Pacific Union. Dr. Evermann is chairman of the Fisheries Section of the Union and will urge the necessity for an early international

treaty for the protection of the marine mammals, fishes and other natural resources of the Pacific.

Dr. T. H. Macbride, president emeritus of the State University of Iowa, has left for San Juan Island, north of the Straits of Juan de Fuca, to study slime moulds.

Dr. F. E. Breithut, U. S. chemical trade commissioner, returned to the United States on June 19, after a year spent studying conditions in the dye-producing countries abroad.

Joseph Mailliard, curator of birds and mammals; Frank Tose, chief taxidermist, and John Malloch, of the California Academy of Sciences, have returned to San Francisco from an extended collecting trip in northeastern California, where they obtained material for a number of new habitat groups of mammals and birds that will be installed in the academy's museum in Golden Gate Park. They secured many specimens of birds and mammals which have been added to the research collections of the academy, and also made a number of discoveries relating to the bird and mammal fauna of that part of California.

W. W. Sargeant, secretary of the California Academy of Sciences and of the Pacific Division of the American Association for the Advancement of Science, is spending a year in Europe. During his absence, Dr. Barton Warren Evermann, director of the museum of the California Academy of Sciences, will serve as acting secretary of the Pacific Division. While in Europe Mr. Sargeant will visit book dealers and libraries in the interests of the academy library.

Vilhjalmur Stefansson, the Arctic explorer, who has started on an expedition into central Australia, is accompanied by the government geologist, L. K. Ward, of Adelaide.

Mount Geikie, 10,854 feet in height, the hitherto impregnable peak of the continental divide, has been scaled by Cecil Wales, of Edmonton, M. D. Geddes and Val E. Fynn, of St. Louis, Mo. Mount Geikie is in Jasper National Park.

A committee has been formed under the honorary presidency of M. Millerand and M. Poincaré, to erect at Sion-Vaudèmont, a monument to Maurice Barrès, distinguished for his work on the organization of science in France.

Dr. J. G. Lipman, dean of the college of Agriculture at Rutgers University, was one of the speakers at the celebration of the eighty-first anniversary of the founding of the Rothamsted Experimental Station, Harpenden, England.

Lieutenant-Colonel Andrew Thomas Gage, director of the Botanical Survey of India and superintendent since 1906 of the Royal Botanic Gardens, Calcutta, has been appointed librarian and assistant secretary to the Linnean Society of London.

Dr. James A. Faris, research fellow of the Brooklyn Botanic Garden, is investigating smut diseases of grain, for the purpose of which a gift from private funds has been made.

At the Mellon Institute of Industrial Research of the University of Pittsburgh, an industrial fellowship on the treatment of timber has been established. This research, which is being sustained by the Grasselli Chemical Co., of Cleveland, Ohio, and is being conducted by Dr. A. M. Howald, has for its purpose a study toward improvement of the methods of applying zinc chloride in the wood-preservation industry.

William T. Richards, Ph.D. (Harvard '24), has been awarded a fellowship in science by the International Education Board. He sailed early in July for Europe, and will study next year in the Cavendish Laboratory, Cambridge.

Dr. Charles Schuchert, of Yale University, will deliver a twelve weeks' course of lectures in advanced stratigraphy in the University of Arizona next winter.

Sir Jethro Justinian Harris Teall, eminent geologist and formerly director of the Geological Survey of the United Kingdom, has died at the age of seventy-five years.

Frederic Merrifield, a well-known British entomologist, died on May 28, aged ninety-three years.

Sir James J. Dobbie, lately government chemist and formerly director of the Royal Scottish Museum, Edinburgh, has died at the age of seventy-one years.

Dr. R. M. Walmsley, principal of the Northampton Polytechnic Institute in England, and formerly professor of electrical engineering and applied physics at the Harriat-Watt College, Edinburgh, died following a street accident on June 15 at the age of seventy years.

The United States Civil Service Commission announces a competitive examination for associate mechanical engineer. Applications close on August 19. The examination is to fill a vacancy in the office of the Chief of Air Service, War Department, Washington, D. C., and vacancies in positions requiring similar qualifications, at an entrance salary of $3,000 a year. The duties of this position, under direction, are to develop improvements and supervise or conduct experimental tests on apparatus for the production, storage, purification and handling of helium, hydrogen and related gases.

The Society for the Promotion of Engineering Education held its thirty-second annual meeting at the University of Colorado, Boulder, from June 25 to

28. The attendance, 362, exceeded all former records. The 150 members present represented 70 colleges, 38 states, Canada and Hawaii. The new officers of the society are: *President,* Dean A. A. Potter, of Purdue; *vice-presidents,* Professor R. S. King, Georgia Institute of Technology, and Dean G. B. Pegram, Columbia University; *secretary,* Dean F. L. Bishop, of Pittsburgh; *treasurer,* W. O. Wiley, of New York. The 1925 meeting will be at Union College, Schenectady, N. Y.

AT the first annual meeting of the American Orthopsychiatric Association held at the Institute for Juvenile Research, Chicago, on June 10, the following officers were elected: *President,* Dr. William Healy, Boston; *vice-president,* Dr. Arnold L. Jacoby, Detroit, and *secretary-treasurer,* Dr. Karl A. Menninger, Topeka, Kans. Among the speakers were Drs. Douglas A. Thom, Boston; David M. Levy, Chicago, and Bernard Glueck and Victor V. Anderson, of New York. The association was organized to study crime and other conduct disorders from a psychologic standpoint. Active membership is limited to psychiatrists engaged directly in the study and treatment of behavior disorders.

AT the annual meeting of the Canadian Medical Association held in Ottawa from June 17 to 20, under the presidency of Dr. John F. Kidd, Ottawa, the following officers were elected for the ensuing year: *President,* Dr. David Low, Regina, Sask.; *editor of the Canadian Medical Association Journal,* Dr. Alexander D. Blackader, Montreal, Que.; *treasurer and managing editor,* Dr. Alfred T. Bazin, Montreal; *chairman of council,* Dr. Alexander Primrose, Toronto, and *general secretary,* Dr. Thomas C. Routley, Toronto.

THE Pan-Pacific Food Conservation Conference to be held under the auspices of the Pan-Pacific Union, in Honolulu, from July 31 to August 14, will comprise the following groups: (1) International agreements regarding fisheries. (2) Economic entomology. (3) Plant pathology. (4) International quarantine policies. (5) Crop production and improvement. (6) Forestry. (7) Climatology. (8) Transportation and distribution of food products. (9) Topography—land and sea. (10) Animal husbandry.

UNIVERSITY AND EDUCATIONAL NOTES

A BUDGET of $24,240,000 has been drawn up for the reconstruction of the Imperial University of Tokio. The buildings were largely destroyed by the earthquake and fire of September 1, 1923.

S. A. COURTAULD has made a donation of £20,000 to endow the university professorship of anatomy in the medical school of Middlesex Hospital, London.

THE new medical college of the University of Rochester was dedicated, June 14, with the laying of the cornerstone by Dr. Benjamin Rush Rhees, president of the university. Dr. Edward Bright Vedder, Lieutenant-Colonel M. C., U. S. Army, was the principal speaker.

DR. KARL TAYLOR COMPTON, professor of physics at Princeton University, has been appointed professor of physics at the University of Chicago.

DR. HENRY C. SHERMAN, who has taught in the department of chemistry at Columbia University since 1899, has been designated Mitchell professor of chemistry, a title previously held by Dr. Charles F. Chandler.

DR. EUGENE L. PORTER, assistant professor of physiology at Western Reserve University, Cleveland, has been appointed professor of physiology at the University of Texas, succeeding Dr. Charles C. Gault, resigned.

DR. LLOYD W. TAYLOR, of the University of Chicago, has been appointed professor of physics at Oberlin College.

DR. T. S. LOVERING, of the University of Minnesota, has been appointed instructor in geology at the University of Arizona.

AT a meeting of the senate of the University of London, held on June 25, Professor E. A. Gardner Yates, professor of archeology in the university, tenable at University College, was elected vice-chancellor for 1924–25, in succession to H. J. Waring.

J. E. P. WAGSTAFF, fellow of St. John's College, Cambridge, and lecturer in physics in the University of Leeds, has been appointed professor of physics at Durham University.

DISCUSSION AND CORRESPONDENCE

A WIDESPREAD ERROR RELATING TO COPERNICUS

IN Volume 6 of the "New International Encyclopedia," 1923, under the word "Copernicus" we find the following statements: "Having become enamored of the study of astronomy, he projected a journey to Rome in his enthusiastic admiration of Regiomontanus, who resided there and was then the most illustrious of the astronomers. On his arrival, in 1500, he was kindly received by Regiomontanus." A somewhat similar statement appears on page 347 of volume 1, 1923, of Smith's "History of Mathematics," and also in the fourth edition of Lippincott's "Biographical Dictionary," 1915, under the name "Copernicus." An amusing feature as regards these statements is the

fact that Regiomontanus had died in 1476, more than twenty years before Copernicus arrived in Rome, according to the date given above. In fact, Copernicus was only a little more than three years old when Regiomontanus died, and hence the numerous references to his having studied astronomy under Regiomontanus, which appear in many places besides those noted above, are ridiculous.

The main justification for calling public attention to such errors seems to be that such publicity may tend to check the baneful influences of these errors, and hence it seems to be especially desirable to direct attention to the comparatively few errors which remain in the most meritorious of the extensively used books. In view of the fact that the present writer was criticized in a recent number of this periodical, volume 59, page 191, for directing attention to a minor error relating to a pioneer in mathematical research in our country, he would simply say that his remarks were not intended for those who see practically no difference between the statements "in charge of the Nautical Almanac," and "did much work on the Nautical Almanac," and "was consulting astronomer from 1849 to 1867." He would also like to state here that his interest in the correction of historical errors was not inspired by the feeling that he himself had never committed such an error, but, on the contrary, by the chagrin caused by being so frequently misled by authorities in whom he had placed undue confidence. The destruction of undue confidence is an important step in the study of the history of science.

G. A. MILLER

UNIVERSITY OF ILLINOIS

A NOTE ON MIGRATION OF MYRIAPODA

THE periodic migrations of certain insects and other animals have held the attention of biologists for generations and continue to afford items of fresh interest from time to time. A careful survey of the literature on this subject does not reveal any previous observations recorded on migrations of centipedes; in fact, it appears the universal consensus of opinion that centipedes do not migrate.

Last August (8–18–23), while crossing the desert stretch between Lordsburgh and Mesilla Park, New Mexico, in company of Professor Oscar B. Jacobson, of the University of Oklahoma, we encountered what appeared to be a migration of centipedes. We had driven along for a number of minutes paying little or no attention to the black objects scattered here and there in our pathway. When at last they became so numerous that the wheels of our Ford killed one every yard we stopped just long enough to notice that these objects were centipedes. They measured from five to seven inches in length and belonged to the genus Scolopendra, order Chilopoda. It was high noon when this scene was encountered. With only an occasional exception, these creatures were headed due north, progressing at a fair pace. A feature of unusual interest to me was their uniform distribution over the ground, each one apparently occupying a space of about four or five square feet. There was no vestige of vegetation present in this region nor even kindly rocks which might have afforded shelter for these creatures. We thought of possible mishaps to our "Lizzy," the thirsty radiator and perhaps a forced stay in this most uninviting, inhospitable environment and drove on. Fully ten more minutes were consumed in driving through this sea of centipedes, and countless victims remained behind in our tracks. We breathed a sigh of relief when the scattered outposts were reached and the burning sands alone reflected the heat of the brilliant desert sun.

I am at a loss to explain the phenomenon just cited. The time of the day when the observation was made does not agree with the normal habits of centipedes, which are nocturnal. Of course we know that certain birds, whose activities are restricted to daylight, make prolonged nocturnal flights during their migrations.

The nature of the terrain, sand without vegetation or rock shelter, coupled with the fact that all the creatures seen were adults and the mass movement was unidirectional, is, I believe, sufficient reason to preclude a breeding ground.

It is true that the month of August is in the rainy season of that section of New Mexico, for we were daily pursued by or chasing a storm until after we passed Tularosa on our way to Roswell. Tremendous quantities of water flow from all directions toward the principal depressions of the desert, the so-called sinks. If the presence of water had driven these centipedes from their haunts, why would they not scramble for dry ground in all directions?

Any theories suggested placing the responsibility for this phenomenon would, for the want of proof, remain as mere conjectures. To summarize: the time of the day when the observation was made, the enormous number of individuals making up this vast colony and the unidirectional course they pursued add only mystery to this observation until it is substantiated by someone else and studied at length.

JOSEPH M. THURINGER

DEPARTMENT OF HISTOLOGY AND EMBRYOLOGY,
SCHOOL OF MEDICINE,
UNIVERSITY OF OKLAHOMA

CORRECTION OF NAME OF SNAIL

RECENTLY, in SCIENCE of May 16, 1924, N. S. Vol. LIX, No. 1533, the writer published a note giving an account of the training of a snail in this laboratory. Unfortunately the writer had been incorrectly informed as to the proper designation of the subject

of the experiment. This fact was called to his attention. He is indebted to Professor Wm. H. Dall, Hon. Curator, Div. Mollusks, U. S. Nat. Museum, and to Professor Junius Henderson, Curator of Museum, University of Colorado, who after careful examination of specimens resembling the subject of the experiment pronounce the snail *Rumina decollata* Linne. According to these authorities these snails are natives of Europe and were introduced into this country and now flourish in Texas which is the source of supply of the snails being studied in this institution.

THOMAS R. GARTH

UNIVERSITY OF DENVER

INTERNATIONAL SEED EXCHANGE

NEARLY a hundred botanic gardens in different parts of the world issue annually or biennially a seed list for the purpose of mutual exchange. In the past two years nearly 3,000 different genera of plants have been offered in these lists.

The botanic gardens publishing seed lists are chiefly those of Europe. Outside of Europe are in Asia four, namely Tokyo, Sapporo, Buitenzorg and Tiflis; in Africa two: Kirstenbosch near Cape Town, and Tunis; in South America: Montevideo; in North America: Ottawa and Brooklyn.

Are there not other institutions, for example, in the Western States, or in Australia, that might be interested in receiving seeds from different parts of the world in exchange for those of their local plants? The undersigned invites correspondence regarding this matter.

ALFRED GUNDERSEN,
Curator of Plants

BROOKLYN BOTANIC GARDEN

SCIENTIFIC BOOKS

Nervous and Mental Reeducation. By S. I. FRANZ. pp. 225. New York, Macmillan, 1923.

STUDIES in reeducation were among Dr. Franz's first contributions, and this volume summarizes an accumulated experience in the subject. It is treated from the standpoint of reeducation of specialized capacities, as of paralyzed limbs or speech functions, and only briefly from the standpoint of the personality as a whole, for example, in the final chapter on "The Psychotic." The viewpoint is that of the physiological psychologist, distinctly from the therapeutic angle. The reading group to which it appeals is a broad one, including the physician interested in the management of voluntary motor dysfunction, and the non-medical specialist concerned with reeducative methods, as the occupational therapist. The first three chapters discuss general psychological principles as related to the special topic; here the author's clearness of style shows to exceptional advantage and makes one feel that if he is ever interested to do so, he can give us a text in general psychology to rival Woodworth's. In these pages and even more so in the second section of the volume, "General Reeducation Principles," he stresses the advantage of quantitative methods in reeducation. This is the portion of most interest from the point of view of experimental psychology, and contains suggestions that may well be assimilated into psychometric technique, *e.g.*, the hammer and nail exercise of p. 80, the tennis ball exercise of p. 87, the walking exercise of p. 110.

A drawback of the volume is its brevity, though this will be judged lightly by workers in allied fields who themselves venture on the task of writing books. It is apparent that chapters of a few thousand words, covering the reeducative aspects of poliomyelitis, of tabes, cerebral paralysis and speech defects, must be very fragmentary or very condensed. This book gives the latter impression. How much many who read the book for information will get from these chapters is an open question. Limitations of space seem to have excluded almost everything in the way of case material; the value of the latter for the present topic can hardly be overstated, and few can be in so good a position to make these contributions as Dr. Franz. This feature gives to the volume an introductory character, and a good deal is left to the further interest and learning capacity of the reader. In this connection one may wish that other and more casuistic work might be made better available by references, though Mackenzie's notable contributions to the general field are duly recognized.

On this topic from this author, one expects a work of great concreteness and practicality, and is not disappointed. It may be noted that Dr. Franz is one of the few whose contributions to the medical field have won him its honorary doctorate. On both psychological and medical sides, the book is stocked with management counsel. The hope must still be retained that the author will find time to give more insight into the rich casuistic material of which the matter of this book gives evidence.

F. L. WELLS

THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

OPINIONS 78 TO 81

OPINION 78.—Case of *Dermacentor andersoni* vs. *Dermacentor venustus:* On basis of the premises presented, the commission is of the opinion that *Dermacentor venustus* dates from Marx in Neumann, 1897, type specimen Collection Marx No. 122 (U. S. National Museum), from *Ovis aries*, Texas, and that *Dermacentor andersoni* dates from Stiles, 1908, holo-

type U. S. P. H. & M. H. S., 9467, from Woodman, Montana.

Opinion 79.—Case of Lamarck's (1801a) Système des Animaux sans Vertèbres: "Rigidly construed," Lamarck's (1801a) Système des Animaux sans Vertèbres is not to be accepted as designation of type species.

Opinion 80.—Suspension of Rules in the Case of *Holothuria* and *Physalia:* The Echinoderm genus *Holothuria* Linn., 1767, restr. Bruguière, 1791, type *H. termula* 1767 = *H. tubulosa* 1790, and the *Siphonophorae* genus *Physalia* Lamarck, 1801, type *P. pelagica* 1801 = *Holothuria physalis* 1758, are hereby placed in the official list of generic names.

Opinion 81.—The Genotype of *Cimex, Acanthia, Clinocoris* and *Klinophilos:* On basis of the premises before the commission, the common bedbug of Europe, *Cimex lectularius,* is the genotype for *Cimex* 1758, *Acanthia* 1775, *Clinocoris* 1829, and *Klinophilos* 1899 (*Clinophilus* 1903), and its proper technical designation under the Rules is *Cimex lectularius. Cimex* Linn., 1758, type *C. lectularius* is hereby placed in the official list of generic names.

NOTICE TO ZOOLOGISTS OF CERTAIN GENERIC NAMES TO BE INSERTED IN THE OFFICIAL LIST

THE following generic names (with genotype in parentheses) have been submitted to the International Commission on Zoological Nomenclature for inclusion in the official list of generic names.

The secretary will delay final announcement of the votes on these names until November 1 in order to give to any zoologists, who may desire, the opportunity to express their opinions.

Protozoa: *Balantidium* Clap. and Lachm., 1858b, 247 (*entozoon*); *Endamoeba* Leidy, 1879a, 300 (*blattae*); *Giardia* Kunstler, 1882, 349 (*agilis*); *Trichomonas* Ehrenb., 1838a, 331 (*vaginalis*); *Trypanosoma* Gruby, 1843a, 1134 (*sanguinis*).

Cephalopoda: *Argonauta* L., 1758a, 708 (*argo*); *Octopus* Lam., 1799, Prodromus, 18 (*vulgaris*); *Sepia* L., 1758a, 568 (*officinalis*).

Gasteropoda: *Acteon* Montf., 1810, 314 (*tornatilis*); *Ampullaria* Lam., 1799, Prodromus, 76 (*urceus*); *Buccinum* L., 1758a, 734 (*undatum*); *Buliminus* Ehrenb., 1831 (*labrosus*); *Bulla* L., 1758a, 725 (*ampulla*); *Calyptraea* Lam., 1799, Prodromus, 78 (*chinensis*); *Columbella* Lam., 1799, Prodromus, 70 (*mercatoria*); *Helix* L., 1758a, 768 (*pomatia*); *Limax* L., 1758a, 652 (*maximus*); *Littorina* Feruss., 1821, Tabl. Syst., XXXIV (*littorea*); *Natica* Scop., 1777, 392 (*canrena*); *Physa* Drap., 1801, 31 (*fontinalis*); *Planorbis* Müller, 1774, 152 (*cornea*); *Succinea* Drap., 1801, 32 (*putris*); *Tethys* L., 1758a, 653 (*leporina*); *Vitrina* Drap., 1801, 33 (*pellucida*).

Lamellibranchiata: *Anodonta* Lam., 1799, 87 (*cygneus*); *Cyprina* Lam., 1818, 556 (*islandicus*); *Dreissena* Van Bened., 1835, 25 (*polymorpha*); *Mactra* L., 1767, 1125 (*stultorum*); *Margaritana* Schum., 1817, 137 (*margaritifera*); *Mya* L., 1758a, 670 (*truncata*); *Mytilus* L., 1758a, 704 (*edulus*); *Ostrea* L., 1758a, 696 (*edulis*); *Sphaerium* Scop., 1777, 397 (*cornea*); *Tellina* L., 1758a, 674 (*virgata*); *Teredo* L., 1758a, 651 (*navalis*); *Venus* L., 1758a, 684 (*mercenaria*).

Polyplacophora: *Chiton* L., 1758a, 667 (*tuberculatus*).

Scaphopoda: *Dentalium* L., 1758a, 785 (*elephantinum*).

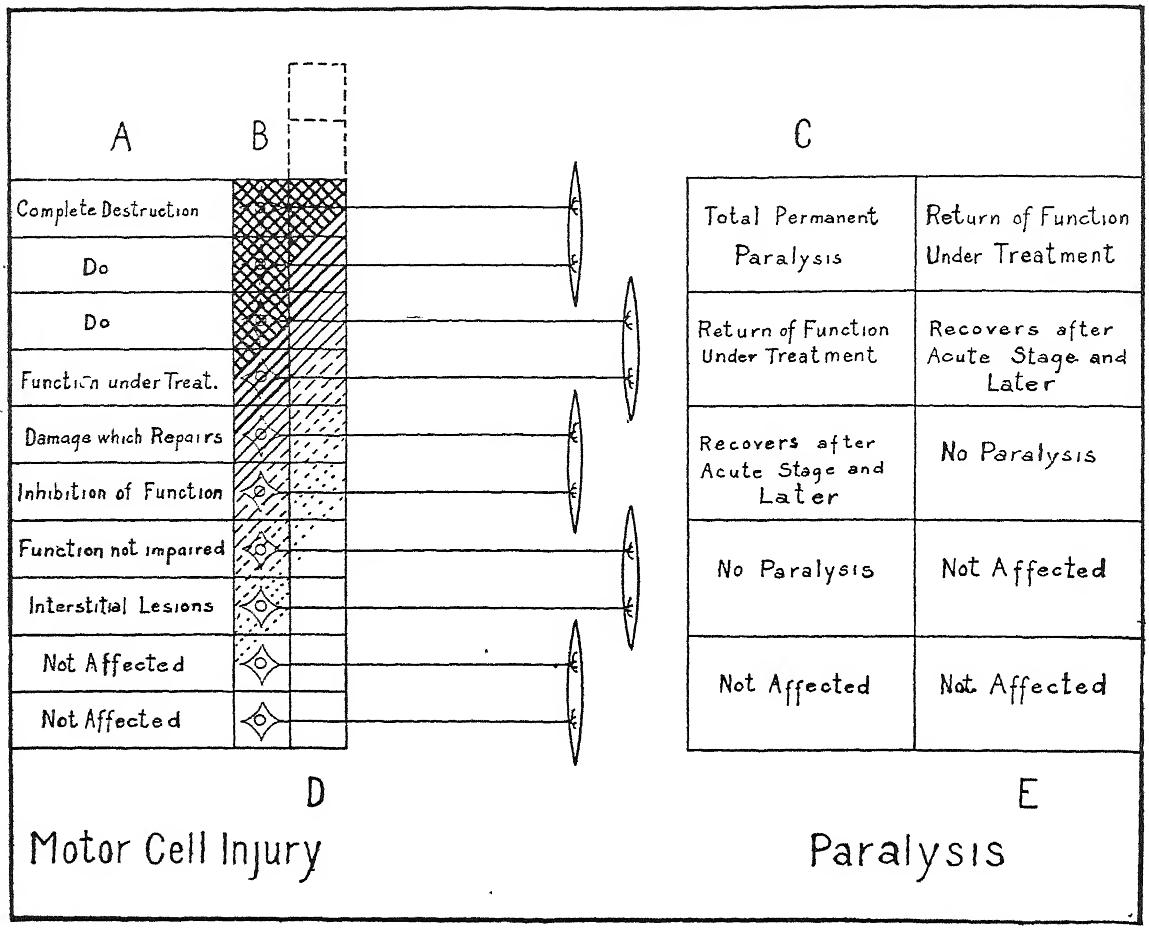
Tunicata: *Ascidia* L., 1767, 1087 (*mentula*); *Botryllus* Gaert., 1774, 35 (*schlosseri*); *Clavelina* Savig., 1816, 174 (*lepadiformis*); *Diazona* Savig., 1816, 35 (*violacea*); *Distaplia* de Valle, 1881, 14 (*magnilarva*); *Molgula* Forbes, 1848, 36 (*oculata*).

C. WARDELL STILES,
Secretary to the International Commission on Zoological Nomenclature
HYGIENIC LABORATORY,
U. S. PUBLIC HEALTH SERVICE

SPECIAL ARTICLES

THE RELATION OF PLURISEGMENTAL INNERVATION TO RECOVERY IN INFANTILE PARALYSIS

THE earlier conception of the pathology of infantile paralysis attributed the paralytic features of the disease to a primary degeneration or atrophy of the anterior horn cells. This conception has been enlarged to include the several other changes in the central nervous system which appear in the acute or paralytic stage of the disease, but damage to the anterior horn cells still holds its place as being directly responsible for the paralytic manifestations. The initial change in the motor cell itself in this disease is atrophy of the intracellular network of the neurofibrillae. The cell body swells and becomes more globular. With this swelling a disintegration of the Nissl granules occurs and often extends throughout the whole cell. In many instances the nucleus retains its normal appearance for a remarkably long time. Generally, it also retains its position in the middle of the cell. The nucleus may even remain after the peripheral part of the cell body is degenerated and dissolved. When a severer change occurs in the cell body, the nucleus is converted into a deeply staining irregular structure. Complete karyolysis takes place at times. Occasionally vacuoles may be seen in the protoplasm. Finally round cells invade and ingest the ganglion cells till only a clump of round cells with greatly increased protoplasm remains to mark the site of the ganglion cell. The nerve filaments of the gray matter are faintly stained and of irregular contour. Sometimes they present small swollen nod-



ules, or they may be degenerated so that only fragments may be recognized.

Although the muscular areas involved in the paralytic process have been more or less closely associated with the lesions in corresponding segments of the spinal cord, this can not be said to have been worked out in sufficient detail to permit an accurate correlation between the varying degrees of cell injury and the several grades of severity which are observed in the paralyses which result. Undoubtedly such a relation exists. A correct conception of this relation is highly desirable, especially from the standpoint of treatment of the paralyses.

During the past two and one half years, I have inoculated a number of monkeys (*Macaccus rhesus*) with a strain of the virus of infantile paralysis which was obtained on October 29, 1921, from the spinal cord of a fatal case of the disease. This virus has produced the experimental disease in monkeys in a milder form than is usually seen. For the most part the animals have recovered, but always with more or less paralysis. Hence it has been possible to observe the progress of the paralytic manifestations over varying periods of time. In respect to disability, atrophy, contractures and improvement, the events in the course of the experimental disease correspond to those in human beings. No attempt has been made to treat the individual paralyses, but the fact that these lame monkeys restrict their activities to a great extent is probably a factor in the improvement which takes place. In this respect, the animals may be compared with a patient following a régime of rest.[1]

The progress of these animals as to recovery from paralysis may be divided as follows:

Improvement in paralysis at termination of acute stage.
Improvement after six to eight weeks.
A gradual improvement later.
No improvement.

The improvement which occurs at the termination of the acute stage of the disease is often considerable and abrupt. These circumstances suggest that it is to be associated with the removal of factors which have merely inhibited the function of the motor cells, such as edema. The improvement which takes place after six or eight weeks or longer may also be exten-

[1] Jones, Robert, and Lovett, Robert W.: "Orthopedic Surgery," William Wood and Company, 1923.

sive as well as quite sudden. This we are inclined to associate with motor cells which have suffered actual injury and have undergone repair.[2] The gradual improvement which sometimes occurs seems more properly to be associated with the taking up of function by other motor cells.

Upon the unisegmental theory of innervation, the varying degrees of recovery are ascribed largely to the stimulation of remaining active fibers, but this does not entirely account for the improvement which takes place, especially that which comes late in the disease. The doctrine of plurisegmental innervation of individual muscle fibers which has recently been emphasized by Cattell and Stiles[3] seems to offer a more adequate explanation of the phenomena of recovery and to stimulate the hope that function may be restored in muscles which under the older conception are sometimes considered beyond repair. The manner in which plurisegmental innervation may operate in recovery is presented schematically in the accompanying diagram. The different degrees of motor cell involvement are given under A and illustrated graphically under B, with the corresponding paralysis shown under C. This schematic drawing shows both nerve cells of the first muscle fiber completely destroyed, which produces a total and permanent paralysis of this fiber. One nerve cell of the next muscle fiber is completely destroyed but its fellow is brought into play under reeducational treatment. The next cell represents the lesion which is associated with a paralysis which recovers sometime after the acute stage of the disease, while the sixth cell is one whose function is inhibited only while the acute process exists in the central nervous system tissue.

There is still a question whether the motor cell injury in infantile paralysis is produced by the direct action of the virus or toxins produced by it, or whether the injury is secondary to the interstitial lesions. There is considerable evidence that the latter is the case—that the nerve cell undergoes changes resulting from disturbances in its nutrition which are due to the interstitial lesions.

When it is recalled that the damage to the motor cells is accomplished in a very short time, one can not but be impressed by the effects which would undoubtedly follow even a slight reduction in the extent or duration of these interstitial lesions. Among the possibilities in this connection are the reduction of edema, the promotion of the circulation of the perivascular fluid, the destruction of even a small portion of the virus present by specific means, or the neutralization of irritating substances acting locally. Recent important advances in the physiology of the central nervous system[4] have opened new avenues of approach to this question.[5] It does not seem too much to hope that means can be found which will change the picture in the central nervous system to that represented in D, thus modifying the problem of the orthopedist to that shown in E.

W. Lloyd Aycock

From Dept. of Preventive Medicine and Hygiene, Harvard Med. School, Boston, and the Research Lab., Vermont State Board of Health, Burlington

[2] Buzzard, E. F., and Greenfield, J. G.: "Pathology of the Nervous System," 1923.

[3] Cattell, McKeen, and Stiles, P. G.: Science, 1924, N. S., LIX, 383.

[4] Weed, L. H.: *Jour. Med. Research*, 1914, N. S., XXVI, 93; Weed, L. H., and Hughson, Walter: *Am. Jour. Physiol.*, 1921, LVIII, 53; Weed, L. H., and McKibben, Paul S.: *Am. Jour. Physiol.*, 1919, XLVIII, 512.

[5] Aycock, W. L., and Amoss, H. L.: *Johns Hopkins Hospital Bull.*, 1923, XXXIV, 361.

THE AMERICAN CHEMICAL SOCIETY

Section of History of Chemistry

F. B. Daines, *chairman*
Lyman C. Newell, *secretary*

Lewis C. Beck, M.D., a pioneer in the food and drug adulteration movement of America: L. F. Kebler. Dr. Beck received both a literary and a medical training. He was identified with several institutions of learning, among them the Albany Medical College and Rutgers College of New Jersey. He taught materia medica, pharmacy, botany and other natural sciences. These all gave him a good background to write his book entitled "Adulterations of Various Substances Used in Medicine and the Arts," printed in 1846. In 1848 an appropriation of $1,000 was made by Congress to make certain chemical analyses. Dr. Beck was selected to do this work, and his two reports made in 1848–9 constitute the first records of the Department of Agriculture dealing with the great problem of food and drug adulteration.

A sketch of agricultural chemistry in America from 1663–1863: C. A. Browne. The history of agricultural chemistry in America is briefly reviewed from the time when Governor John Winthrop, of Connecticut, presented his report before the Royal Society upon the "Description, culture and use of maize," down to the time of the establishment of the U. S. Department of Agriculture in 1862. Rev. John Clayton's report on the "Observables of Virginia," in 1688, contains the first reference to the chemistry of American soils. The interest of Presidents John Adams and Thomas Jefferson in the practical applications of chemistry to agriculture is mentioned. Allusion is made to the early investigations of John Taylor, Gerard Troost, C. V. Sheppard, Edmund Ruffin, S. L. Dava, J. P. Norton, Evan Pugh, J. W. Draper, Ebenezer Emmons, Eben L. Horsford, Benjamin Silliman, Jr., C. A. Goessman, S. W. Johnson and other chemists and to their publications upon agricultural chemistry. A great impetus was given to agricultural chemistry in America in the decade 1840–1850 as a result of the publication of Liebig's "Chemistry in its Application to Agriculture,"

and of the beginning of the U. S. Patent Office reports upon agriculture. The latter contain contributions by Campbell Morfit, J. C. Booth, L. C. Beck, C. T. Jackson and other prominent American chemists upon agricultural topics.

Mauve: Perkin's discovery: BENJAMIN HARROW. In the early fifties, particularly under Hofmann's guidance, chemists took great interest in the artificial formation of natural substances. From Hofmann's remarks, Perkin was led to experiments on the artificial formation of quinine. As little was then known of the internal structure of compounds, the method of reasoning employed and the type of experiments undertaken in the conversion of one substance into another were crude. Perkin gives us an excellent example of this: "It (quinine) might be formed from toluidine by first adding to its composition C_3H_4 by substituting allyl for hydrogen, thus forming allyl toluidine, and then removing two hydrogen atoms and adding 2 atoms of oxygen. The allyl toluidine, having been prepared by the action of allyl iodide on toluidine, was converted into a salt and treated with potassium dichromate; no quinine was formed, but only a dirty reddish brown precipitate. Unpromising though this result was, I was interested in the reaction, and thought it desirable to treat a more simple base in the same manner. Aniline was selected; its sulfate was treated with potassium dichromate; in this instance a black precipitate was obtained, and, on examination, this was found to contain the coloring matter now so well known as aniline purple or mauve."

Charles W. Eliot—Chemist: LYMAN C. NEWELL. Charles W. Eliot, president of Harvard University for forty years, began his career as a chemist. While an undergraduate he did experiments by himself in Professor Josiah P. Cooke's private laboratory. Upon graduation, he became Professor Cooke's laboratory assistant, soon a tutor in chemistry, and finally assistant professor of mathematics and chemistry. When in Europe, from 1863–1865 he studied chemistry. In 1865 he was appointed professor of analytical chemistry and metallurgy at the newly opened Massachusetts Institute of Technology. In cooperation with Frank H. Storer, he made four original investigations and wrote two text-books. In 1869, he resigned to become president of Harvard University.

New light on phlogiston: TENNEY L. DAVIS. The phlogiston doctrine of Stähl appears to have been anticipated or suggested about a century before his time. Hapelius, in 1606, argued that phlogiston is the essence of the alchemical sulfur. He described an ingenious experiment in which sulfur is produced from antimony sulfide by the action of aqua regia, "common green brimstone, which *ipso facto* you will find to be phlogiston and you will find that it does not differ from common sulfur in that respect." The vocabulary of Hapelius, his problem and his solution of it are those which were later elaborated by Stähl and which dominated the science of chemistry until the time of Priestley and Lavoisier.

Pioneer applied chemistry in North America: GEO. L. COYLE, S. J. To obtain knowledge of the application of chemistry by the aborigines in North America, recourse was had to the missionary accounts of their customs sent annually to their superiors in Europe. These sources of information—The Jesuit Relations—cover a period from 1610 to 1754. Here we learn the methods of agriculture, the preparation of food, methods of making fire, cooking of maize, meat and fish, the preservation of fish and meat by smoking, the whale, porpoise and seal fisheries, whence the natives derived oil for food and toilet purposes, the drinks they used, their sources of roots and simples for medicine. Here also we learn of their clothing, textiles and skins, their primitive method of tanning and dressing leather, their sources of dyes and pigments, the colors for tattooing. We find them acquainted with the art of pottery, brick-making, the preparation of lime from shells, and even hydraulic cement. Descriptions are given of the copper mines of Lake Superior and elsewhere, of the aboriginal method of smelting lead, of reduction of iron ores and the forging of tools, metal working for utility and ornament. The discovery of salt and its use in preserving fish, petroleum, natural gas and coal were known to some tribes, altogether an interesting picture of applied chemistry in the 17th and 18th centuries.

John Maclean—Chemist: WILLIAM FOSTER. Dr. John Maclean (1771–1834) was the first professor of chemistry in the College of New Jersey, Princeton (1795–1812). He was born at Glasgow and was educated in the universities of Glasgow and Edinburgh and in London and Paris. Dr. Maclean specialized in surgery and chemistry, but he was a very broadly educated man. In his twenty-first year he became a member of the Faculty of Physicians and Surgeons, Glasgow, and his learned friends considered that he had no superior in Scotland. Being in sympathy with the political sentiments of America, he emigrated to this country in 1795, and came to Princeton where he delivered a short course of lectures on chemistry in the summer of that year, and in October was chosen professor of chemistry and natural philosophy, and taught with great distinction. As a physician, a surgeon, a natural philosopher, a mathematician, and, above all, a chemist, Dr. Maclean was eminent. Dr. Benjamin Silliman, the first professor of chemistry at Yale, saw his first chemical experiments at Princeton, and in his diary he acknowledges Dr. Maclean as his earliest master in chemistry and Princeton as his starting point in that subject.

Martin Hans Boyé (Lantern): EDGAR F. SMITH.

Researches in alchemy: ARTHUR J. HOPKINS.

M. Carey Lea's allotropic silver (with original samples): CHARLES E. MUNROE.

Memorabilia of famous chemists: EDGAR F. SMITH and LYMAN C. NEWELL.

The early iron industry in Alabama: ELTON R. DARLING.

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THE RELATION OF BOTANY TO AGRICULTURE[1]

THE relation of botany to agriculture is an interesting subject to discuss, whether stated in this form or as the relation of agriculture to botany. It is capable of being stated in a dozen other forms, equally suggestive. In every one of its aspects it has been discussed and rediscussed until little remains except to piece together selected fragments of excellent thought into the skeleton of a new picture, somewhat as a composite is made of the photographs of hundreds of men and women in a picture that sometimes is thought to present the character of the whole though no one of its components may be recognizable in it,—or one may dominate all the rest.

Without agriculture, there would be no botany. Without botany, agriculture would be little more than empiricism; but this empiricism would contain in itself the seeds of evolutionary improvement, out of which botany must inevitably grow. The interrelation is a little like that of nutrition and sensation in an animal, and you can trace a large number of parallels between the two cases if you wish.

If, when and as (to quote the stock promoters) the human world becomes stabilized in its mastery of itself and its environment, it may standardize and codify all that it knows and does into a uniformity of action and corresponding expression that will make the choice of words easier than it is now. An imaginative Chinese student of agriculture a few years ago pictured an approach to this condition—in one direction—by considering the waste areas of the earth's waters to be covered by floating gardens from continent to continent between favorable isotherms; much as an imaginative engineer might picture the roofs of our houses converted into a continuous highway for terrestrial use marked here and there by landing stages for aerial birds of passage.

At present we not only use different words to convey essentially identical ideas and the same word to convey ideas that are not the same, but we have a confusing habit of defining our expressions differently or, through mental reservations, of talking about something else when we have accepted a nominal definition of a word.

To some people, the word botany is broad enough to comprise anything whatever directly concerning plants: their structure, their function, their interrelations with one another and with environing nature, their structures or stores that we appropriate to our

[1] Sigma Xi address at Iowa State College, May 3, 1924.

own uses, their response to a little protection in reseeding our vanishing forests, their pliability under the hands of the cultivator and the breeder, in fact, anything in which the name plant or any of its synonyms or subdivisions figures.

Not long since, an educator, who is not a biologist but one sympathetic with science, criticized a general college course in botany as too comprehensive because it touched on such topics as the ecology, physiology and pathology of plants. Possibly he would have defined botany in the time-honored sense of a century ago when to be a botanist one must "know plants" and when, as Professor Torrey once expressed it, one who did not "know" four hundred plants was hardly qualified as a professor of botany.

The one-time dean of a great college of agriculture, who at the same time was a botanist who knew his four hundred plants, among other things used to begin his lectures on general botany by stating that botany is the science that concerns itself with plants, that science is organized knowledge and that plants are—well, what are plants anyway?—let us say, living things that are not animals.

A Spanish author accounts for the bull-fighting instincts of his race by carrying these back to the time when that race was a race of hunters and of tamers and then breeders of animals, and that passed to the regulated procedure of the arena by way of the less democratic inquisition.

If, as some people would deny, our remote ancestors were tree-dwellers, they must have been vegetarians to a large extent. Even after that great epoch of progress that the teachers of evolution delight in picturing, when they learned to hold their own on the ground and to defend themselves against the brutes that had claws and fangs and horns, they must have eaten fruits and succulent stems and leaves and starchy roots in larger quantity than flesh. A Darwinian would say that even our teeth show this. How many generations it must have required to pick out and reject the harmful of these reservoirs of nourishment and latent solar energy. How many generations more it must have required to transform some of their crude weapons into even cruder tools and to have acquired the art of transplanting and protecting the best of these!

That, and the domestication of animals, constitute the dawn of agriculture. Before the day of the Jews, and that was five thousand years ago, the art was crudely practiced. Its practice contained in itself the rudiments of biology—this much can be seen in the Scriptures and in echoes of the earliest civilizations. By the time of the Greeks, with their analytical minds and their didactic habits, very much seems to have been known or thought here and there about plants.

Very likely it was Aristotle who winnowed and selected and shaped up this knowledge and tradition, this plant-lore, into a rational whole: but it was his friend and pupil Theophrastus who first put it into permanent written form. As a science, an organized assemblage of the knowledge of plants, botany thus came into existence several hundred years before the Christian era began.

When the idealistic Greek was being supplanted by the more practically minded Roman, agriculture came into its own. Science seems not to have been much talked of, but the pleasures and profits of country life appealed to writers—and to readers without whom there would have been little call for writers. Students of the joint evolution of botany and agronomy and horticulture, find an interesting contrast between the Inquiry into Plants of Theophrastus, three centuries before the birth of Christ, and the Natural History of Pliny near the end of the first century of the Christian era. The one is the orderly organization of a science, containing germs of applicable knowledge rather than prescriptions for its application. The other, with the chaff less carefully winnowed from the grain, is an encyclopedic compendium of what was known or believed.

History is said to repeat itself. The curious thinker possibly may find that, to-day, readers prefer the practical conclusions at end of a learned dissertation to painstakingly mastering the details on which these conclusions are based. Every teacher has noticed that students are keener for the sweets and the nuts in a course than for the meat that must be chewed. I must confess that I myself prefer Bailey's Cyclopedia to the great Floras—for many purposes.

If we follow my friend the dean in considering botany to be the science that deals with plants, we shall have to go a bit further along the same road and consider that—if animals are living things that are not plants—zoology is the science that concerns itself with animals.

Whether or no we frankly consider ourselves as being animals, we have to face the fact that our own natural history and morphology and anatomy and physiology and pathology stand out in particular emphasis in one's mind when these words are mentioned, so that it is not very surprising that separate sciences —first anatomical and physiological, then pathological —should have broken free within the general science of zoology. At first human, then comparative, these offshoots have hung for a time loosely to the parent science, then have separated and drifted away from it like jellyfish from a medusa.

To-day, like chemistry and physics, a knowledge of the general laws of these segregates is presupposed for intelligent study of the generalized and comprehensive science of which they were a part originally

and in which they still enter in its broad and synthetic understanding.

I never have heard it said how many animals one should "know" if he is to qualify as a professor of zoology; but as there are several times as many kinds of animals as there are of plants, it probably would not fall far short of two thousand on the basis adopted for a botanist. The major part of these kinds of animals probably fall among the insects, those wonderful little creatures that sometimes surpass us in social subordination of the individual, in industry and in thrift, and that at times rise to a superhexapoecian if not almost a human intelligence.

Zoologists now and then fall back on selected types of insects like potato beetles or fruit flies for analysis of some of the fundamental problems of variation and heredity, of mutation and evolution; but entomology usually stands apart from zoology, now-a-days, as a separate science—possibly because the novice finds it easier to become acquainted with a thousand individual bepestered bees or hungry grasshoppers or thirsty mosquitoes than with a tithe of that number of kinds of insects.

Botany, likewise, has disintegrated as a whole. Its roots are widespread and its branches cover as much ground, but its proliferation has been somewhat different from that of zoology. Like a Canada thistle it has sent its offsets up in competition with each other and with the parent stock. They are tenacious of the ground that they hold and are not easily eradicable, but they have not that enviable independence of environment that the anatomy and physiology of animals have enjoyed through their relation to the human frame and to life.

In a way comparable with entomology, bacteriology has broken away from the parent stock, with directly economic aims; a modicum of demonstrable structure to work from, but a world of intricate physiological problems to be solved—developing, even, a physiological basis of classification quite its own and not found successfully applicable elsewhere in biology. Debatably plants or animals, these smallest and least structurally specialized of living things, the bacteria, may well be left as the most tenable of protista, in the hope that for them a science may be evolved finally comparable with botany and zoology.

Some years ago the dean of a college of agriculture asked my opinion as to whether—since time could not be spared for both—an elementary course in botany or such a course in zoology should be required in his college, or whether one or the other should be required according to agricultural specialization along the different lines of plant industry or animal industry. It was and remains a hard question to answer.

A few years ago if the question had been asked publicly the answer would have been shouted "Neither: a course in general science!" Half a century ago, when too exclusively descriptive zoology and botany were being revivified by Huxley and his South Kensington associates, the answer would have been "Neither: a course in biology!" Both would have been right: but—I do not say that this is my own opinion—it is claimed often enough to receive attention that a department of biology has the advantage of calling for one professor instead of two, and that one does not need to be a professor, even to teach general science. Possibly, of course, any such opinions rest on a disbelief that a professor of zoology could be found "knowing" his 2,400 kinds of plants and animals—or that an expounder of general science really could be expected to have personal acquaintance with a score in both fields, to say nothing of the constellations and the chemical elements and so on.

My answer to the question asked me, given for what it was worth, was to the effect that—judging from a money standard only—plant industry is twice as important as animal industry, in agriculture, that both depend upon the functioning of living things, that this physiological functioning is closely dependent upon structure differentiation, that structure and function in the main are simpler in plants than in animals; well, perhaps the drift of the argument was that the essential general principles of coordinated structure and function could be taught more simply through botany, and at any rate that green plants are the food-makers for the whole world, so that successful animal life never can be divorced from productive plant life, and that even the stock man, in the main, must have an agronomist's understanding of plant life thoroughly as a foundation for his own specialization.

For very many years I had been out of close connection with botany as taught in agricultural colleges as contrasted with botany as taught elsewhere. During these years it had been my business and my pleasure to keep a pretty close watch on the growth and trend of botanical literature, and now and then I had scanned with interest some new text on agricultural botany or on botany for students of agriculture.

Then I was invited to head the department of botany in one of our great state universities which included an unusually strong college of agriculture. Before replying to the invitation I made a pilgrimage to my old campus, Cornell, to ask of an authority —the dean of the college of agriculture at Ithaca—what botany was needed for such a college that was not needed elsewhere; because that college at Cornell had been absorbing most of the botany of the entire university.

The answer was short and simple, and the argu-

ment supporting it was direct, as any one who knows L. H. Bailey will understand, "Botany for agriculture need not be different from botany for anything else; it ought to be botany; good morphology—more of the kind that Asa Gray used to teach, good physiology, and personal acquaintance with plants."

That *is* botany, after all, isn't it, and can agriculture dispense with botany?

There are two very different ways of looking at questions: the—disinterested, I might say—way of viewing them quite impartially from the outside, and the—perhaps selfish—way of seeing how they may be answered most profitably to us.

Mitchell recently has analyzed our national life and habits and rather unflatteringly tells us that though we have learned a good many things we have not learned how to live.

This process of not learning begins when as very little children we ask questions that our elders—Barrie would say our betters—can not answer. Every one who has seen the racing speed with which the years convert a questioning child into a "don't-know" grown-up has had a chance to see what brings about the change.

School and college are too busy with other, perhaps more obvious, matters to bother with correcting this little detail. This may suggest what I mean when I speak of the different viewpoints on any question taken from the outside and the inside. Until critical—perhaps too often destructively critical—analyses, like that of Mitchell, shall have come home to us in betterments of what we proudly call the finest educational system in the world, we certainly shall not have learned to live—as Mr. Eliot has expressed it, to get the joy out of life.

We are traveling very rapidly now along the road of vocational training, a road that is making of us successful specialists in the great fundamental industries of agriculture, manufacture, engineering and commerce, as well as in what sometimes are spoken of as the learned professions—or the professions, for short. Material national prosperity lies along this road, but if we are to conquer what Mitchell takes to be our national malady we can not wear blinders as we travel it; we must see and enjoy the delights of living as we perform the work that for most of us, happily, gives the means of living.

So the relations of botany to agriculture, as I see them, go far beyond the class-room where botany is taught as a foundation or as a part of agriculture. They begin with the child's interest in everything about it, they touch the reservation of a bit of the home surroundings for a flower-garden pure and simple, they put more than a money value on the woods pasture and the bog meadow, they preserve in natural parks for coming generations some of our heritage of nature which should be inalienable.

I have read many essays on botany, past, present and to-be. I have noted with concern that it is less taught even than formerly in our secondary schools. I have found, more than once, after recommending a teacher of botany to a superintendent, that he has had to get some one who also could direct athletics. I have shared the lament of a distinguished botanist, converted into an eminent agronomist, that botany, however suitable it may be, is not aggressively coming into its own as fundamental to the art out of which it has grown and which as it has grown it has lifted to undreamed-of successes. These and many more of its failures are matters of every-day observation.

Botany, more even than zoology, has suffered through the segregation of its application. When Mr. Wilson was secretary of agriculture, a skilful organization brought together under him the federal branches dealing with agricultural botany—all but forestry which stood and still stands apart from the Bureau of Plant Industry: the significance of ecology was not then so evident as now.

It is not so very many years since in an agricultural college one man served as professor of botany, of horticulture and of forestry, though agronomy as a part of plain agriculture even then stood by itself. To-day, if more than one of these subjects be found in a department it is usually for reasons of administrative correlation rather than because of their consanguinity.

Like agronomy, these specialties all rest on a knowledge of the structure and the work and the environmental relations of plants, all of which conform to laws that form a part of the science of botany and that, under whatever name, have been framed by botanists.

One might almost venture the assertion that whether called a clerical, like Mendel, a farmer, like Lawes, a horticulturist, like Burbank, or an unclassified naturalist, like Darwin, all those men who have made great economic plant-industry advances have been in reality botanists.

If I were to sum up in general terms the relations of botany to agriculture in college, I should say that, whether called genetics or agronomy, every fundamental step in plant breeding is botany; whether called floriculture or olericulture, every recognition of mutation and every selection based upon it is botany; whether called fighting weeds, in agronomy, or reseeding the wood-lot, in forestry, every ecologically grounded procedure is botany; whether you practice prophylaxis or quarantine or bring into existence resistant races, every step in combating plant

disease is directly applied botany; and even the season for most satisfactory pruning, the selection of full-weight seeds and the proper utilization of those that are under-ripened, all rest on botanical discovery brought about—under whatever name you like—by botanical investigation.

The day may come possibly when we shall place all such botanical studies in the hands of doctors of agronomy or doctors of olericulture or doctors of pomology; but learned as the agronomists and olericulturists and pomologists and other specialists are who are adding untold wealth to the country every year through their specially trained and concentrated skill, it appears that to-day for the most part these men actually are doctors who have taken their major work in botany, and minor work only in the paramount field within which they planned to apply their training in this fundamental science, The relation is somewhat that between discovery and invention—with larger financial rewards on the applied side.

So, as to college botany in relation to agriculture, I come back to Bailey's opinion that agriculture needs and ought to have instruction in the essentials of botany—good morphology, good physiology, to-day good ecology, and personal acquaintance with plants.

A real morphologist, with a free hand, can teach the morphology that is needed. Unfortunately, a free hand means free time: he may find that, possibly; but, and this is crucial, his students do not.

A modern physiologist seems to find a modern laboratory necessary if he is to teach the necessary physiology. Quantitative exactness is so much a part of a subject so largely physico-chemical, that we do not appear to pause long enough to realize that its high points were worked out qualitatively and organized into unity without such appliances; but time fails the student even if the teacher see the broader and more generalized side of his needs, or can meet the more specialized requirements.

The hardest part of the prescription to fill, though, is supplying a personal acquaintance with plants: and this should be the easiest. Most agriculturists who talk to me about the shortcomings of students find that they do not "know" plants.

Colleges, and particularly agricultural colleges, suffer tremendously now-a-days from being urban or suburban institutions. They suffer correspondingly from being gigantic institutions. Even with gardens, if we have them, though we may carry reduced advanced classes along, specimen in hand, we can not do this adequately for the beginners who need it most; and few of us have even such gardens as, for example, the old-fashioned course in medical botany has given to so many European universities.

My idea is that the botany needed in agriculture must begin before college and specialization are reached—let us say, for the moment, in the high school. That simplifies it very much—or would simplify it if Bailey's simple prescription could be filled in the high school. Fifty years ago that might have been looked for. Botany did not comprise much more than the elements of descriptive morphology and a personal acquaintance with common (we called them familiar) wild and garden flowers.

This acquaintance is not given now in most high schools because the teacher has missed it. The prospective high school teacher of botany finds now that he or she must be prepared to teach history or mathematics or something else, as well. The bars are being raised steadily, and on excellent argument, for a prerequisite in education that in some states surpasses the major requirements in a balanced college curriculum.

Certainly the educated college student can not be allowed to go out without a general high-points knowledge of the working of the world's food-makers-plants; of the wonders of even their complex mechanism; of the nucleus of each and every cell, which means so much for its formation and functioning; of its chromosomes—the mechanical basis of heredity. But where is the background?

A reaction that it appears very easy to get with a large beginning class in botany illustrates one of the difficulties in the way of making progress in any line of botany. Did you ever sketch the current belief in some phenomenon or other as merely the working hypothesis of the moment, picture its ultimate establishment or replacement through investigation under exact control of conditions and an isolation of factors such as Mendel or DeVries would have ensured and say casually, "Some one of you may give an answer to this question"? The heehaw with which a class looks around for the goat—outward and rarely inward—would be very amusing if it were not so very pitiful.

It takes a long time for the idea of producing to enter into most of us, who are born and educated as consumers: yet somewhere among these beginners is found the material out of which investigators are shaped up when maturity has brought the idea that the opportunity of life really is an opportunity of balanced give and take. After a century and more it is as hard to make the beginner realize that we are merely on the threshold of knowing and understanding nature as it was when Linnaeus, the great systematizer of biological science, showed an unknown moss under his hand, placed at random on the ground, to a student who was expressing his sympathy with the master who knew all nature and

yet spent so much of his time in teaching to others what he knew perfectly.

Here is the kernel of what I am trying to say. Nature-knowledge, whatever you call it, must be brought back into the home—and this ought to be through the kindergarten and the primary school. Teachers in these schools ought to be helped in high school to "know" the plants and the birds and the common insects and other denizens of field and forest.

A high school teacher of biology—under any name—who can not help the forming grade teachers to get this knowledge really is not fitted for the place he holds: but college too rarely can or does fit him. Until what we call our educational system is reformed through evolution or revolution, I fear that we must look for the beginnings of this knowledge where they lay several generations ago—among the self-helped and self-taught fathers and mothers to whom little children turn—at first—in the confidence that they know or have or will learn or will get what is asked for whenever it is neither unreasonable nor harmful. My heart is very warm for the person groping for such self-help: and for the simple-minded apostle of a real nature-knowledge, who in the complexity of our specializations and prerequisite requirements can not reasonably hope to get or hold a teacher's place, whatever he may know, unless he produce some sort of academic sealed and be-ribboned open-sesame.

If ever we can get back to this common possession of our modestly educated forefathers—and the means of self-education are myriad now where they were few for our ancestors—no college class will smile at the thought that it may contain a potential Hales, or Hofmeister, a Gray, or Mendel. Self-evidently it will contain the fundamental of inherent acquaintanceship with the great makers of food concerning which it is acquiring knowledge; and the fact that this knowledge is oscillating and vacillating in its progress toward the real and the full truth will stimulate its every alert member (if this perfection of college classes may be expected) to thinking for himself on the problems and the means of solving them. Then, as formerly, we shall rely on such self-guidance rather than on mimeographed mechanical outlines of work.

Here, in the class-room—even without laboratories, greenhouses or herbaria or gardens—lies our own personal point of contact with the relation of botany or of any science to agriculture—or to anything else. The inspiration of an enthusiastic teacher, an indefatigable investigator, an aging man who never can become encysted by age but whose horizon increases with the years is the contribution of college and university that develop it. These are the men who make laboratories, who devise means to ends—whom others follow.

WILLIAM TRELEASE
UNIVERSITY OF ILLINOIS

ON THE AVIFAUNA OF THE CAPE VERDE ISLANDS[1]

RECENT field work for the American Museum of Natural History has supplied specimens and data for a study of the bird life of the Cape Verde Islands. Water birds, in particular, are so well represented in the collection that it has been possible to employ statistical methods in determining the range of individual variation in certain species, and to contrast, by means of frequency graphs, variation of this kind with geographic variation, *i. e.*, true specific or subspecific variation.

The avifauna of the Cape Verde group comprises 75 forms, of which 37 are seasonal or casual visitants from breeding grounds elsewhere, and three are introduced species. Of the 35 native resident birds, 9 are oceanic, while 8 may be considered Palearctic, 7 Ethiopian and 11 neutral.

The last and largest of these assemblages includes birds of five classes, namely: (1) Those whose breeding ranges extend from areas north of the Mediterranean southward into Africa (*e. g.*, the flamingo and the Egyptian vulture); (2) those which range even south of the forest belt in parts of Africa, but which breed also from southern Europe eastward into Asia (*e. g.*, the white egret, which is resident in India and Ceylon); (3) those which are alike related to representative forms to northward and to southward (*e. g.*, the endemic courser and barn owl, the latter of which is a member of an almost cosmopolitan species); (4) those characteristic of the northerly part of the desert zone, some of which have close relatives in Egypt, Arabia or southwestern Asia (*e. g.*, a lark, *Alaemon*, and a raven, *Corvus ruficollis*); (5) those which have a large proportion of their congeners in South Africa, but which, nevertheless, show closest affinity with species found at the northern edge of the Sahara (*e. g.*, a lark, *Ammomanes*, etc.).

The avifauna is therefore neither prevailingly Palearctic, as Wallace believed, nor distinctly Ethiopian, as has been held by more recent naturalists.[2] It is rather a transition fauna, with numerous desert types akin to birds found along the northern border

[1] Abstract of a paper read before the New York Academy of Sciences on December 10, 1923.

[2] Wallace, A. R., 1876. "The Geographical Distribution of Animals," I, pp. 214, 215. Neumann, O., 1918. *Journal für Ornithologie*, LXVI, pp. 235, 236. Bannerman, D. A., 1920, *Ibis*, pp. 560, 561.

of the Sahara, and with a high proportion of endemism—more than 40 per cent.

Even more indicative of the desert affinities of the insular bird life is the fact that most of the distinctly Ethiopian types have their nearest continental relatives not in the neighboring Congo forest toward the southeast, but rather in an encircling belt of territory which forms a loop around the forest in East Africa and extends into South Africa. Thus, an endemic finch of the Cape Verdes (*Passer jagoensis*) is closely related to *Passer cordofanicus* of the upper White Nile, *Passer ruficinctus* of East Africa, and *Passer motitensis* of the arid parts of South Africa, while no representative occurs in the Congo.

In both relative position and zoogeographic aspects, the Cape Verde Islands are somewhat analogous to the Galapagos Islands, situated westward of South America, in a lower latitude and in a different meteorological environment.

The Cape Verdes owe their prevailing aridity chiefly to the fact that they are tropical islands which lie to leeward of relatively cool ocean waters. The group is truly oceanic, with a flora and fauna derived from elsewhere after the volcanic formation of the islands.

Meteorological and oceanographic conditions resulting from the northeast trade wind cause the mean temperature of the surface of the ocean about the Cape Verde Islands to be lower than that of the atmosphere. This is at variance with conditions in the western tropical and north temperate Atlantic, and is correlated with significant features of sea bird distribution. Thus the islands are the northernmost outpost in the eastern Atlantic of the breeding range of tropical Steganopodes (booby, tropic bird, and frigate bird), whereas all these birds reach higher latitudes in the western Atlantic. In like manner, the tropical species of terns penetrate much farther north in the western than in the eastern part of this ocean. To express the difference by an example, it may be said that the hiatus between the breeding ranges of a tropical tern, *Anous stolidus,* and a Holarctic tern, *Sterna hirundo,* is fifteen hundred miles wide in the eastern Atlantic, and less than six hundred miles wide in the western Atlantic. At the Cape Verdes there are no native terns or other Laridae.

These circumstances undoubtedly have to do with marine ecology, for the limits in the breeding range of both tropical and north temperate sea birds prove to be closely correlated with certain isotherms of ocean temperature.

Robert Cushman Murphy

American Museum of
Natural History

SCIENTIFIC EVENTS

THE TORONTO MEETING OF THE BRITISH ASSOCIATION

Oversea members of the British Association for the Advancement of Science coming to the Toronto meeting, beginning on August 6, include the following:

Section G—Engineering

President—G. W. O. Howe, James Watt professor of electrical engineering, University of Glasgow, and editor of the *Radio Review*. His presidential address will deal with "A hundred years of electrical engineering."

Vice-president—Sir Henry Fowler, chief mechanical engineer of the Midland Railway, will speak on "Metallurgy and its influence on social life."

Recorder—F. C. Lee, professor of civil engineering, University of Birmingham.

Secretary—A. Robertson, professor of mechanical and mining engineering, University of Bristol.

Secretary—J. S. Wilson.

T. Hudson Beare, Regius professor of engineering and dean of the faculty of science of Edinburgh University.

Henry Borns.

Ernest J. Coker, professor of civil and mechanical engineering, University of London.

G. Cook, professor of mechanical engineering, King's College, University of London.

George Forbes, late electrical engineer for the works at Niagara Falls.

B. P. Haigh, professor at Royal Naval College, Greenwich.

Sir James B. Henderson, adviser in gyroscopic equipment to the Admiralty, and professor of applied mechanics, Royal Naval College, Greenwich.

Charles Frewin Jenkins, professor of engineering science in the University of Oxford.

Sir William John Jones.

Edgar Waldorf Marchant, professor of electrical engineering, University of Liverpool.

Hon. Sir C. A. Parsons, chairman of the C. A. Parsons Company, Newcastle-on-Tyne, and the Parsons Marine Steam Turbine Company. Past president of the British Association.

H. P. Philpot, professor of civil and mechanical engineering in the City and Guilds Technical College, London.

Section M—Agriculture

President—Sir John E. Russell, director of the Rothamsted Experiment Station, England, will deliver his presidential address on the subject of "Combination in attacking farmers' problems" and will discuss "Diminishing returns in agriculture."

Vice-president—Charles Crowther, director of research, Olympia Agricultural Company; formerly professor of agricultural chemistry, and head of the Institute for Research on Animal Nutrition in the University of Leeds.

Recorder—C. J. T. Morison, School of Rural Economy, Oxford.

Secretary—T. S. Dymond, London.

Secretary—G. Scott Robertson, head of the chemical research division, Ministry of Agriculture and chief agricultural analyst for Northern Ireland.

Rt. Hon. Lord Charles Bathurst Bledisloe, chairman of the committee for agricultural research, Bristol University, will discuss "Diminishing returns in agriculture," in joint discussion with Section F.

A. W. Borthwick, on staff of Forestry Commission, England.

Malcolm James Rowley Dunstan, principal of Royal Agricultural College, Cirencester.

R. A. Fisher, chief statistician in Rothamsted (Agricultural) Experiment Station, Harpenden, Herts.

Sir Robert Blythe Greig, chairman of the Board of Agriculture for Scotland.

Sir John McFadyen, principal and professor of comparative pathology, Royal Veterinary College, London, will speak on "Contagious abortion in relation to animal husbandry."

Sir Henry Rew, formerly assistant secretary of the Board of Agriculture and Fisheries.

Sir Stewart Stockman, chief veterinary officer and director of veterinary research with the Ministry of Agriculture and Fisheries, will speak on "Tuberculosis in relation to animal husbandry."

R. G. White, professor of agriculture in the University College of North Wales, Bangor.

THE ITHACA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE sixty-eighth meeting of the American Chemical Society will be held at Cornell University, Ithaca, N. Y., from September 8 to 13. The first day will be occupied with registration and council meetings. The general program follows:

SEPTEMBER 9, 9:30 A. M.

Bailey Hall—general meeting. Dr. Livingston Farrand, president of Cornell University, presiding.

Addresses of welcome.

Response: Dr. Leo Baekeland, president of the American Chemical Society.

General addresses. Sir Max Muspratt, "Chemistry and civilization"; Professor S. P. L. Sorensen, "Serum globulins"; Sir Robert Robinson, "The chemistry of the trinitrotoluenes."

2:30 P. M.

Baker laboratory, main lecture room.

Description of the laboratory: Dr. L. M. Dennis, director of the department of chemistry, Cornell University.

Inspection of laboratory, equipment and exhibits.

8:30 P. M.—Bailey Hall

Entertainment for members and guests.

SEPTEMBER 10, 9:30 A. M.

General meetings of physical and inorganic, industrial and chemical education divisions. Divisional meetings.

8:30 P. M.

Bailey Hall—President Leo H. Baekeland, presidential address; President Livingston Farrand, public address. (Titles to be announced.)

SEPTEMBER 11, 9:30 A. M. AND 2:30 P. M.

Divisional meetings. Evening open.

SEPTEMBER 12, 9:30 A. M.

Divisional meetings.

2:45 P. M.

Boat from foot of Buffalo Street to Salt Works, Taughannock and Glenwood Hotel or tennis, golf and other diversions.

7:00 P. M.

Dinner and dance at Glenwood-on-Cayuga.

SEPTEMBER 13, 9:00 A. M.

Trips to points of industrial or scenic interest.

The following are the addresses of the divisional and sectional secretaries:

Agricultural and food chemistry, C. S. Brinton, U. S. Food Inspection Station, 134 S. 2nd St., Philadelphia, Pa.

Biological Chemistry, R. A. Dutcher, Department of Agricultural Chemistry, Pennsylvania State College, State College, Pa.

Cellulose chemistry, L. F. Hawley, Forest Products Laboratory, Madison, Wis.

Chemical education, Neil E. Gordon, University of Maryland, College Park, Md.

Dye chemistry, R. Norris Shreve, 74 S. Munn Ave., East Orange, N. J.

Fertilizer chemistry, H. C. Moore, Armour Fertilizer Works, 209 W. Jackson Blvd., Chicago, Ill.

Industrial and engineering chemistry, E. M. Billings, Kodak Park, Rochester, N. Y.

Leather and gelatin chemistry, Arthur W. Thomas, Department of Chemistry, Columbia University, New York City.

Chemistry of medicinal products, H. A. Shonle, 115 E. 28th St., Indianapolis, Ind.

Organic chemistry, J. A. Nieuwland, Notre Dame, Ind.

Petroleum chemistry, G. A. Burrell, Columbia Bank Building, Pittsburgh, Pa.

Physical and inorganic chemistry, H. B. Weiser, Rice Institute, Houston, Tex.

Rubber chemistry, Arnold H. Smith, 6748 Newgard Ave., Chicago, Ill.

Sugar chemistry, Frederick J. Bates, Bureau of Standards, Washington, D. C.

Water, sewage and sanitation chemistry, F. R. Georgia, Department of Chemistry, Cornell University, Ithaca, N. Y.

Gas and fuel section, O. O. Malleis, 333 Melwood St., Pittsburgh, Pa.

History of chemistry section, L. C. Newell, 688 Boylston St., Boston, Mass.

Paint and varnish section, W. T. Pearce, N. D. Agricultural College, Agricultural College, N. D.

THE COST OF GERMAN PUBLICATIONS

The following resolution was unanimously adopted at the twenty-seventh annual meeting of the Medical Library Association, held in Chicago, Illinois, on June 9 and 10:

Whereas many of the German publishers of medical books and periodicals are making unreasonable and unjustifiable charges for their publications to foreign subscribers and especially discriminating against American subscribers,

Therefore, be it resolved that it is the sense of this meeting that the Medical Library Association go on record expressing its disapproval of this unfair discrimination and urging the library and individual members of the association to discontinue the purchase of German medical books and periodicals until such time as the German publishers adopt a more equitable policy toward the American subscribers regarding prices; and further urging the discontinuance entirely of the purchase of all German books and periodicals unless prompt evidence is given of a change of attitude on the part of the German publishers and agents.

Therefore, be it further resolved that a copy of these resolutions be sent to every library and individual member of the Medical Library Association and to our American Consul General in Berlin, to Mr. M. L. Raney, chairman of the American Library Association Committee on Book Buying, and to the editors of the following periodicals for publication: *Journal of the American Medical Association, Borsenblatt des deutschen Buchhandels, Publishers Weekly, The Library Journal, Public Libraries,* Science.

Committee on resolution regarding prices of German Medical Publications,

Charles Frankenberger, *Chairman,*
J. Christian Bay,
Charles Perry Fisher

THE AMERICAN ASSOCIATION AND THE NAPLES ZOOLOGICAL STATION

The grant made by the American Association for the Advancement of Science to the Zoological Station at Naples has been accepted, and the director of the station, Dr. Reinhard Dohrn, has expressed his appreciation of the grant in the following paragraph taken from a letter to the permanent secretary:

I have received your letter communicating to me the vote of the American Association for the Advancement of Science to grant $500 for an American working table at our Zoological Station, and I wish to tender herewith my heartiest thanks for this very valuable material help to our institute, and particularly for the moral support coming from such a highly representative body as the American Association for the Advancement of Science. My collaborators and I, who are just engaged in bringing the Zoological Station again to an efficient working order, do highly appreciate this encouragement of American Science to our endeavors and I trust that the Zoological Station will succeed in rendering again good service to American biologists as it had been our privilege in the past.

The association wishes to name an occupant for the working table at Naples, and the permanent secretary will be glad to receive applications from scientists who may wish to take advantage of this. Dr. Dohrn states that he will be glad to correspond with persons who are planning to work at the Naples station.

Burton E. Livingston,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

Robert Meldrum Stewart has been appointed director of the Dominion Observatory at Ottawa in succession to the late Dr. Otto Klotz.

Andrew Thomson has been appointed director of the Apia Observatory, Western Samoa, under the administration of the New Zealand government.

Dr. Florence R. Sabin, professor of histology at the Johns Hopkins Medical School, has been appointed a member on the scientific staff of the Rockefeller Institute for Medical Research.

The Franklin medal and certificate of honorary membership in the Franklin Institute awarded to Sir Ernest Rutherford, Cavendish professor of physics at the University of Cambridge, was presented at a special ceremonial, held in London, on July 14.

Dr. William H. Welch, director of the School of Hygiene and Public Health, Johns Hopkins University, has sailed for Europe to attend the conference on public health at Geneva.

Dr. Samuel T. Darling, of the International Health Board of the Rockefeller Foundation, was elected president of the American Society of Tropical Medicine at the annual convention held from June 9 to 10, in Chicago.

F. M. Farmer, chief engineer of the Electrical Testing Laboratories, New York, was elected president of the American Society for Testing Materials at the recent convention held in Atlantic City.

Dr. P. S. Helmick, of Drake University, has been elected secretary of the Iowa Academy of Science in succession to James H. Lees, of the Iowa Geological Survey, who has resigned after ten years of service.

Professor G. Fichera, of the University of Pavia, has been awarded the Santoro prize by the National Academy of Sciences at Rome, for his researches on cancer.

RAPHAEL ZON, director of the Lake States Forest Experiment Station, has been appointed corresponding secretary of the Finnish Forestry Society, the object of which is to promote scientific forest investigations in Finland.

THE St. Louis office of the Bureau of Mines, Department of the Interior, was discontinued on July 1. C. E. Van Barneveld, superintendent of the Mississippi Valley Station, Rolla, Mo., with which the St. Louis office was connected, has resigned. B. M. O'Harra is acting as superintendent of the Rolla Station.

AN office of the petroleum division of the Bureau of Mines is being established at the University of Wyoming. D. B. Dow, who has been attached to the Petroleum Experiment Station at Bartlesville, Okla., will be the engineer in charge of the Laramie office.

DR. GEORGE H. GODFREY, who was for ten years in the United States Bureau of Plant Industry, has accepted a position in agricultural research with the Beyer Company, New York.

G. H. CHENEY, formerly an instructor in chemistry at the University of Illinois, is now employed as a research chemist with the Dow Chemical Co.

SAMUEL F. HILDEBRAND, of the United States Bureau of Fisheries, left early in June for Augusta, Ga., from which point he will continue the investigation of fishes in relation to mosquito control in cooperation with the Public Health Service.

DR. CHARLES W. HARGITT, research professor of zoology, Syracuse University, has been invited to membership in the Pan-American Scientific Congress which meets in Lima, Peru, in November next, by the president and secretary general, on behalf of the organization committee. Dr. Hargitt will submit to the congress a report on some recent investigations.

PROFESSOR G. W. RITCHEY, of the Carnegie Solar Observatory, California, gave an illustrated lecture at the general meeting of the Astronomical Society of France held at the Sorbonne on June 18.

A GIFT of $1,000 to establish a trust fund in memory of their son, Carl G. Kremers, has been received by the University of Wisconsin from Professor and Mrs. Edward Kremers. Professor Kremers is director of the university course in pharmacy and of the Pharmaceutical Experiment Station. The fund will be used by the station for research in furtherance of chemotherapy.

THE *Journal* of the American Medical Association states that the statue erected in memory of the anatomist Farabeuf has just been unveiled at the Faculty of Medicine of Paris. Addresses were delivered by Professor Sébileau, a former pupil of Farabeuf, in the name of his colleagues of the Faculty of Medicine; Professor Lejars, as the representative of the Academy of Medicine, and Professor J. L. Faure, in behalf of the Société de Chirurgie.

WE learn from *Nature* that at the University of Leeds, England, a fund has been raised with the object of signalizing the distinguished services which Professor Arthur Smithells had rendered to the community and particularly to the science of chemistry and the University of Leeds during his thirty-eight years' tenure of office as professor of chemistry. A portrait is to be painted of Professor Smithells for presentation to the university, and a fund of at least £2,000 will remain for the endowment of a scholarship.

DR. DUDLEY A. SARGENT, president and founder of the Sargent School for Physical Education, Cambridge, and formerly director of the Hemenway Gymnasium of Harvard University, died on July 21, in his seventy-fifth year.

DR. HARVEY R. GAYLORD, for twenty-five years director of the State Institute for the Study of Malignant Diseases at Buffalo, died on June 23, at the age of fifty-two years.

DR. WILLIAM ALPHONSO WITHERS, professor of chemistry in the North Carolina State College of Agriculture and Engineering since its establishment in 1889, died suddenly on June 20, at the age of sixty years.

PROFESSOR PHILIP B. HASBROUCK, for twenty-nine years head of the department of physics at Massachusetts Agricultural College, has died.

DR. CHARLES E. MOYSE, emeritus vice-principal of McGill University, Montreal, and emeritus dean of the faculty of arts, has died at the age of seventy-two years.

SIR WILLIAM ABBOTT HERDMAN, formerly professor of natural history and oceanography at the University of Liverpool, and one of the best known marine biologists in Great Britain, died on July 22.

THE legislature having recently authorized the change, Dr. E. N. Lowe, state geologist of Mississippi, is now transferring the museum and the library of the State Geological Survey from Jackson to the State University. The address of the survey will henceforth be University, Mississippi.

THIRTEEN professors and instructors of various universities and colleges attended the fourteenth annual session of the Summer Conference for Engineering Teachers, which was held at the works of the Westinghouse Electric and Manufacturing Company from July 7 to July 31. The program for the conference was worked out so that each member was afforded an opportunity to carry out some line of engineering work. Among the colleges represented

in the conference are the University of Kansas, University of Colorado, New Mexico Agriculture and Mechanics College, Alabama Polytechnic Institute, Harvard Engineering School, Cornell University, University of Iowa, Oregon Agricultural College, Brooklyn Polytechnic Institute, Purdue University and the Victoria Jubilee Institute of Bombay, India.

The Medical Research Council of London announces that it has awarded Rockefeller Medical Fellowships, tenable in the United States during the academic year 1924–25, to the following: Robert Keith Cannan, senior assistant in biochemistry, University College, London; John Josias Conybeare, assistant physician and warden of the College at Guy's Hospital, London; Dr. James Rognvald Learmonth, assistant to the professor of surgery, Anderson College of Medicine, Glasgow; Ethel Marjory Luce, Lister Institute of Preventive Medicine, London; Dr. John William McNee, senior assistant in the medical unit, University College Hospital, London; William Robson, chemical assistant in the department of therapeutics, University of Edinburgh.

Secretary of the Navy Wilbur has approved a project of the Naval Observatory for sending an expedition to observe the total solar eclipse in Sumatra in January, 1926. From the observations to be made it is believed that valuable data will be obtained regarding magnetic disturbances on the sun.

The International Medical Commission for combating malaria has arrived at Warsaw. The commission, which was appointed by the League of Nations, will proceed later to Russia to continue its researches and inquiries.

The California Academy of Sciences is sending a collecting party from its department of entomology into the southern Arizona mountains to collect and study the Sonoran fauna of this region. The party will be in charge of E. P. Van Duzee, curator of entomology in the academy, assisted by J. O. Martin. They will leave San Francisco about the fifteenth of July and remain in the field from four to six weeks, visiting the Santa Catalinas, the Huachucas and possibly others of the southern mountains.

An expedition into the little known parts of China will be conducted for the next two or three years by explorers of the Department of Agriculture. Dr. P. H. Dorsett and his son, J. H. Dorsett, sailed from San Francisco for Shanghai on July 22. Their explorations will be conducted in the Provinces of Chih-Li and Shen-Si and in the rich agricultural territory of Manchuria. They will make intensive studies of agricultural conditions and the principal crops with a view to ascertaining in what way a mutual exchange of seeds and plants can be brought about between China and the United States.

UNIVERSITY AND EDUCATIONAL NOTES

A cablegram reports that the movement to establish an American university in Greece similar to Robert College in Constantinople has been given impetus by the visit to Athens of Professor Robert Andrews Millikan, director of the Norman Bridge Laboratory of the California Institute of Technology at Pasadena. Professor Millikan is reported to be representing a foundation which has allocated $5,000,000 for such a project.

Dr. R. Ahmed, a graduate of the University of Iowa, has opened a dental college in Calcutta, to be called the Calcutta Dental College and Hospital. The staff of twelve members includes a second Iowa alumnus, Dr. P. K. Bose.

Dr. Ralph S. Lillie, of the Nela Research Laboratory, Cleveland, has been appointed professor of physiology at the University of Chicago. In addition to the appointment of Dr. Karl Taylor Compton to be professor of physics, as previously recorded in Science, other appointments include: Dr. G. K. K. Link, associate professor of plant pathology; Dr. Frank E. Ross, associate professor of astronomy at the Yerkes Observatory; Dr. William Taliaferro, associate professor in the department of hygiene and bacteriology; Dr. Fay-Cooper Cole, assistant professor of anthropology, and Dr. H. B. Van Dyke, assistant professor of physiological chemistry.

Dr. Earle R. Hedrick, who has been for twenty-three years professor of mathematics at the University of Missouri, has resigned to become professor of mathematics at the University of California at the southern branch in Los Angeles.

Dr. C. S. Yoakum, who five years ago succeeded Dr. W. D. Scott as director of the Bureau of Personnel Research at Carnegie Institute of Technology, has been appointed professor of personnel management in the newly organized School of Business Administration at the University of Michigan.

Dr. John Dudley Dunham was recently appointed professor of medicine in the college of medicine of the Ohio State University.

Dr. A. C. Walton, formerly professor of zoology at Northwestern College, Naperville, has been appointed professor of zoology at Knox College to succeed Dr. George N. Higgins, who goes to the Mayo Foundation at Rochester to take up research work in comparative anatomy.

Professor Robert H. Gault, of Northwestern University, who will be associated with the National Research Council at Washington during the year 1924–

1925, will give a graduate course in the psychology of the handicapped at George Washington University. His place in Northwestern University will be filled by Professor A. R. Gilliland, of Lafayette College.

A. R. CAHN, PH.D. (Illinois, '24), and F. B. Adamstone, Ph.D. (Toronto, '24) have been appointed instructors in zoology at the University of Illinois.

DR. REYNOLD KENNETH YOUNG, of the Ottawa Observatory, has been appointed associate professor of astronomy at the University of Toronto.

DR. B. B. BAKER, of the University of Edinburgh, has been appointed to the university chair of mathematics at University College, London, tenable at the Royal Holloway College.

DR. MANGIAGALLI, senator and director of the post-graduate work at Milan, has been elected rector of the newly organized university there.

DISCUSSION AND CORRESPONDENCE

DETERMINATION OF "e" FROM MEASUREMENTS OF THE SCHROTT-EFFECT

SCHOTTKY[1] has calculated, under the name "Schrott-effect," the spontaneous variations in thermionic currents that are to be expected if electron evaporation follows the law of probability. These variations depend upon the value of "e". Hartmann[2] attempted to determine "e" by measuring these variations. He succeeded in amplifying the variations to audibility, and by subjective comparison with pure tones of known intensity obtained values of "e" which varied from one fifteeenth the accepted value to three times this value.

We have repeated these measurements, using a radio-frequency amplifier instead of audio-frequency, thus avoiding disturbances due to gas effects or mechanical shocks; and using a "square" vacuum tube detector and d.c. ammeter to measure directly the energy of the Schrott disturbance. *The values of "e" calculated from these measurements are all within 2 per cent. of the accepted value, and the mean differs by less than one half per cent. from this value.*

Schottky's theory is thus fully substantiated, and it appears possible that this method of measuring "e" may yield values comparable in accuracy with the oil-drop method.

The Schrott variations appear to be the same for all types of cathode (pure tungsten, thorium coated tungsten, etc.) provided the current is limited by temperature. *When the current is limited by space charge instead of temperature, however, the Shrott-variations are much smaller.* This is in accordance with the theory, since under space charge conditions the electrons no longer fly off independently, but influence each other in such a way as to smooth out the variations.

ALBERT W. HULL
N. H. WILLIAMS

GENERAL ELECTRIC COMPANY
SCHENECTADY, N. Y.

[1] Schottky, *Ann. d. Phys. 57*, 541–67, 1918; *68*, 157–76, 1922.

[2] C. A. Hartmann, *Ann. d. Phys. 65*, 65, 1921.

AN OSMOSIS EXPERIMENT IN BIOLOGY

IT is customary in an elementary course in biology to set up a demonstration of osmosis. Sometimes the thing does not work. A biology teacher usually performs it as a side line to the regular course work and seldom has time to experiment when it fails.

We have tried various grades of parchment, not always with good result. The solutions would exchange too fast in some cases. Other grades proved impermeable. Our best results have been with chicken crop. The smooth side is put out.

When the craw proves impermeable, the outside should be scraped and 5 per cent. HCl be painted on with a brush. A rise to six feet can then be obtained. I hope this may prove of service to some who have met with troubles.

HAROLD D. CLAYBERG

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LETTERS OF RAFINESQUE

APROPOS of the note on "The Bones of Rafinesque" in the issue of SCIENCE for June 20—it may be of interest to those who care to delve in scientific biography—to know there is on deposit at the Philadelphia Academy of Natural Sciences the Haldeman letters and correspondence which contains the personal letters of Rafinesque, pertaining to his early life not only in America but in Europe. It is a veritable mine of information for any one who may care to prepare a biography of this remarkable character.

JOSEPH LEIDY, II

SCIENTIFIC BOOKS

I. Descriptions and Biology of New or little known Coccids from Japan. By INOKICHI KUWANA. II. *Observations on the Hymenopterous Parasites of Ceroplastes rubens Mask., with Descriptions of New Genera and Species of the Subfamily Encyrtinae.* By TEI ISHII (Dept. Agr. and Comm. Japan, Imp. Plant Quar. Sta., Bull. 3, Aug. 1923, p. 1–68, pl. I–XIV, fig. 1–5 (Art. I.) and pp. 69–114, pl. XV–XIX (Art. II.).

THERE are only three existing copies of this paper, the remainder of the edition having been destroyed by the Japanese earthquake of September 1, 1923. Two of these have been retained in Japan, while the third was brought to Dr. L. O. Howard, chief of the Bu-

reau of Entomology, by Mr. C. P. Clausen, parasite expert of the bureau, at the request of Professor Kuwana. It is to be hoped that the paper will be reprinted eventually, but since several new Japanese species of scale insects and hymenopterous parasites have been described in the paper it seems desirable to give a brief statement as to its contents.

The new species of Coccidae described are the following: *Prontaspis yanonensis*,[1] a close relative of *Chionaspis citri* Comst., from many species and varieties of *Citrus; Geococcus citrinus,* the second representative of this peculiar Pseudococcine genus, on roots of orange; *Rhizoecus kondonis,* another Pseudococcine species, from the roots of orange trees, and *Orthezia yasushii,* stated to occur on wild chrysanthemum and *Artemisia vulgaris.* In addition, the three species of *Ceroplastes* occurring in Japan, *rubens,* Mask., *floridensis* Comst., and *ceriferus* (And.), and *Geococcus oryzae* (Kuw.), previously considered to be a *Ripersia,* are discussed at length. An extended description of the different stages, accompanied by numerous quite satisfactory figures, is given for each species, and the description is supplemented by a discussion of the biology and host relationships of the species where information on these has been obtained.

The second article in this bulletin, as indicated by the title, consists in part of a consideration of the hymenopterous enemies of the introduced coccid, *Ceroplastes rubens,* and in part of technical descriptions of new Encyrtids. An extended discussion of the biology, habits, host relations and economic importance of the two species *Micropterys speciosus,* described as new, and *Coccophagus lecanii* Fitch is given, together with descriptions, accompanied by figures, of the different stages of each species. The general conclusion is reached that neither is effective in checking the increase and spread of the coccid host.

The second part of the paper describes the following new genera and species of Hymenoptera, all from Japan: *Clausenia,* new genus, and *C. purpurea,* new species, reared from *Pseudococcus* sp. on Citrus; *Neocopidosoma,* new genus and *N. komabae* new species, from a Tortricid larva on *Elaeagnus; Cheiloneurus ceroplastis,* new species, from *Ceroplastes rubens* and *C. ceriferus; Anabrolepis japonica,* new species, swept from bamboo infested with *Eriococcus onukii; Anabrolepis bifasciata,* new species, collected by sweeping: *Aphycus timberlakii,* new species, from *Lecanium* sp. on *Euonymus; Microterys ericeri,* new species, from *Ericerus pe-la* on Ligustrum.

Harold Morrison

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[1] First described (in Japanese) as *Chionaspis yanonensis* (Byokin Giachu Iho. Bur. Agr. D. H. Agr. and Comm. Japan, No. 10, 1923, pp. 1–33).

SPECIAL ARTICLES

GLACIAL PEBBLES IN EASTERN KENTUCKY[1]

Within the last year (1923–24) the discovery of erratic pebbles of apparent glacial origin widely distributed throughout northeastern Kentucky has provided the first concrete evidence in support of a hypothesis of Pleistocene glacial ponding in a part of Kentucky heretofore thought to be without glacial characteristic. The occurrence of old elevated stream channels along the Ohio, notably at Huntington, West Virginia; Ashland, Kentucky; Ironton, Wheelersburg and Portsmouth, Ohio, has been known for some time, having been described by Leverett[2] and Tight.[3] These abandoned channels occur at elevations ranging from 680 feet to 690 feet above sea level. While they contain gravels chiefly composed of quartzite and chert of stream origin, possibly more remotely glacial, they are not to be confused with the pebbles which are now being found in remote parts of eastern Kentucky at much higher elevations.

In the course of non-glacial field work geologists on the Kentucky Geological Survey, including the writer, have found 18 pebbles varying in size from a few ounces to 13 pounds, consisting principally of quartzites, but with an occasional granite, gneiss or other crystalline or metamorphic rock. These pebbles range in elevation from 720 feet on the Big Sandy River to 850 feet on the North Fork of the Licking River, and have been found in Lawrence, Elliott, Lewis, Morgan, Carter and Boyd counties. Field evidence indicates that similar pebbles may also be found at similar elevations in parts of Menifee, Greenup and Rowan counties, though these are not a certainty. The drainage systems involved in these discoveries include the Big Sandy River, Little Sandy River and Tygarts Creek, and the North and Elk Forks of the Licking River.

Based on evidence now in hand, which will be supplemented this year by further investigations, the following hypothesis is advanced:

The general accordance of elevations of these pebbles coupled with their certain extraneous origin and decidedly glacial characteristic suggests their invasion into Kentucky by means of floating ice. It is held that they probably represent a complex assortment derived from both river and glacial front sources during the period of readjustment of the northward flowing drainage of this portion of the Cumberland plateau, while cols were being degraded to form the present course of the Ohio River at points just above (1) Ironton, (2) Portsmouth and (3) Manchester, Ohio, and possibly just above Cincinnati. It is

[1] Presented before the Kentucky Academy of Science, Lexington, Ky., May 10, 1924.

[2] Monograph XLI, U. S. G. S., p. 106, 1902.

[3] Prof. Paper No. 13, U. S. G. S., Plate XV2, 1903.

thought that the higher and more remote pebbles (800 to 850 feet) represent invasions by floating ice at the time of the first cutting of the Manchester col, which may have been originally about 850 or 900 feet. Ridges in the vicinity of Manchester now show elevations ranging up to 1,000 feet above sea level. Pebbles occurring in Kentucky at points near to the major drainage at elevations ranging from 720 to 750 feet are taken to represent subsequent ponding during the latter cutting of the Manchester col, and possibly those at Ironton, Portsmouth and Cincinnati. Ridge elevations at Ironton now range between 800 and 850 feet; at Portsmouth between 900 and 950 feet; and at Cincinnati (Dayton, Kentucky-Walnut Hills, Ohio) between 850 and 860 feet.

The section involved in this ponding in eastern Kentucky has not been topographically mapped except in part. Barometric elevations run throughout this section indicate that the highest ridges will range from 1,000 to 1,200 feet. At the highest level of ponding, ridge topography in this section would have appeared insular, the region resembling somewhat the Thousand Islands region of the St. Lawrence. A study of the elevations of these pebbles, their position and the gradient of some high level fluvatile gravels and terraces may possibly bring out the fact of uplift in the southwestern part of the section subsequent to the Pleistocene. The period of ponding at an elevation of 850 feet appears to have been short, as terraces apparently were not widely developed. There is no evidence now in hand to prove the extension of glacial ice lobes into this part of the state. Stratified drift is absent and ridge topography does not show a general beveling. Ponding in northeastern Kentucky at this time very possibly covered an area of about 2,000 square miles.

The occurrence of pebbles at high levels on that part of the drainage of the Licking River which adjoins the Little Sandy River may mean (1) that these ponded glacial waters flowed over one or more low divides in this interior part of Kentucky, and (2) that these southern cols were in direct competition for a time at least with those which were removed at such northern points as Manchester and elsewhere. To accept this theory the assumption of regional uplift in Morgan County and vicinity during and subsequent to the Pleistocene becomes a necessity. Yet this assumption would seem to be far more plausible than (1) a high damming of the Licking River and (2) glacial ice floating southeastward along the serpentine course of the Licking over 100 miles to the Elliott County line.

If the Morgan-Elliott County passes thus brought into prominence were indeed temporary debouchures for impounded glacial waters, to the superior hardness of the lower Pottsville clastics of this region and some coincident regional uplift may be ascribed the present course of the Ohio River bordering northeastern Kentucky. Had the Coal Measure sediments of Morgan and Elliott counties less competently met the erosive action of surging glacial waters the course of the then formative Ohio River would undoubtedly have been directed up the valley of the Little Sandy River and down the Licking River. Such a hypothetical change in the pattern of the Ohio River would have (1) reduced the area of Kentucky by 2,500 square miles, (2) placed Lexington, the heart of the Blue Grass Region, within 35 miles of the Ohio, and (3) profoundly altered the history and economics of the entire lower Ohio valley.

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TEMPERATURE AND MUSCULAR EXCITABILITY

THE influence of temperature on muscular excitability is a problem yet unsettled, although numerous investigations on it have been published. Controversy continues among investigators, who have found different optimal temperatures; some place the optimum at or near 30° C., while others have found it at or near 5° C., and still others have determined two optima situated at these two levels.

The majority of investigators have taken the height of the contraction curve as the indicator of muscular excitability. This indicator, however, is not accurate because many factors may modify it. In my experiments I have used the threshold of contraction when induced break shocks, measured by Martin's method[1] in Z units, were applied to the gastrocnemius muscle of the frog. After the animal was pithed the muscle was excised and placed in a moist chamber surrounded by a water-jacket. The Achilles tendon was directly connected to the myograph. Temperature changes were induced gradually to insure a close correspondence between the reading of the thermometer in the moist chamber and the actual state of the muscle. The threshold was assumed when a minimal movement of the lever made its mark on the drum. The changes in the temperature were made in different ways. At times room temperature was the point of departure, and the temperature was lowered or raised gradually. At other times the start was made from high or low temperature. In the course of longer experiments the range was traversed repeatedly; up and down, down and up. A determination of threshold was usually made after each increment or decrement of one degree.

The results which I have obtained prove that the

[1] Martin: "The Measurement of Induction Shocks," New York, 1912.

threshold is lowest when the muscle is at or near room temperature (18–20° C.). Both the rise and the fall in temperature cause a remarkable rise of the threshold. In the following tables the results of two different experiments are given; it is clear that the lowered excitability, as the temperature is increased or decreased, can not be ascribed to fatigue, because the reverse change occurs on returning to room temperature.

TABLE I

Temperature ° C.	Threshold Z units
19 (Room)	19
14	35
9	45
4	71
0	99
5	80
10	60
15	40
20	36
25	43
30	49

TABLE II

Temperature ° C.	Threshold Z units
17 (Room)	29
0	250
5	185
10	54
15	35
20	32
25	40
30	71
35	344

The height of the contraction curve proves not to be related to the degree of muscular excitability, for although *within certain limits* the excursion of the lever is increased by raising or lowering the temperature and beyond these limits is decreased, the threshold of excitation under the same conditions continues to present higher and higher values. Furthermore, the increase in the height of the contraction curve may be only apparent, as shown by Kaiser,[2] who explained it as a consequence of the imperfection of the apparatus commonly used.

Further experiments will be carried out on this subject with currents of longer duration than those used in the present experiments in order to take into consideration the important evidence adduced by Lucas and Mines regarding the relation of the duration of the stimulus to its stimulating value.[3] In view of the results already obtained, however, enough support seems to exist for the following conclusions:

(a) Neither warming nor cooling increases the excitability of frog muscle—instead, they diminish it;

(b) The optimum temperature at which the excitability of frog muscle appears greatest is that at which the muscle has been maintained before the period of experiment, *i.e.*, the room temperature.

This last conclusion agrees with the conception of Abbott,[4] who states that "for every organism there is an optimum temperature at which it grows and thrives best, and this is apt to be the normal temperature in which the organism naturally occurs."

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[2] Kaiser: *Zeitsch. f. Biol.*, 1896, XXXIII, 157.

[3] Lucas and Mines: *Jour. of Physiol.*, 1907, XXXVI, 334.

[4] Abbott: "General Biology," New York, 1914, 244.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE STANFORD UNIVERSITY MEETING OF THE PACIFIC DIVISION

THE eighth annual meeting of the Pacific Division of the American Association for the Advancement of Science, held at Stanford University June 25 to 28, proved to be fully up to the high standard set by previous meetings. In scientific and popular interest, social features and wholesome enthusiasm, the meeting was all that could be desired. The hospitality of the people of Palo Alto and of Stanford University and of the faculty and officers of the university, in the entertainment of the members of the association and visiting friends, was a marked feature of the meeting.

The total registration was 355. Among those in attendance from distant points were Dr. L. O. Howard, chief of the U. S. Bureau of Entomology, Washington, D. C., a former president and for many years the permanent secretary of the association; Dr. J. McKeen Cattell, president of the association; Dr. George Henry Falkiner Nuttall, Quick professor of biology, Cambridge University; and Dr. T. D. A. Cockerell, of the University of Colorado.

GENERAL SESSIONS

Although the formal opening of the meeting occurred on Wednesday, June 25, one of the affiliated societies—the Western Society of Soil Management and Plant Nutrition—began its sessions on Tuesday morning, June 24.

The registration office was opened Wednesday morning. At the noon luncheon on Wednesday a research conference was held, as has been customary. At this conference President David Starr Jordan presided, and the following named persons presented papers: Dr. Herman A. Spoehr, of the Coastal Laboratory, Carnegie Institution, Carmel, California, on "Photosynthesis"; Dr. Ernest C. Dickson, of the Stanford University Medical School, San Francisco, on "Botulism"; Professor James C. Clark, of Stanford University, on "High tension electrical transmission."

On Wednesday evening, the retiring president, Dr. David Starr Jordan, gave an address on "Science and sciosophy,"[1] following which was given a public re-

[1] This address was published in full in SCIENCE for June 27.

ception. On Thursday evening, Dr. George Henry Falkiner Nuttall, Quick professor of biology, Cambridge University, Cambridge, England, gave an illustrated address on "Symbiosis." The address on Friday evening was given by Dr. J. McKeen Cattell, president of the American Association for the Advancement of Science, his subject being "Psychology as a profession."

On Friday evening, about 60 members and guests made an excursion to Mt. Hamilton, where they were the guests of Associate Director Dr. Robert G. Aitken and staff, of the Lick Observatory. On Saturday about 50 biologists and others made a trip to La Honda and the seashore at Moss Beach.

MEETINGS OF AFFILIATED SOCIETIES

Of the 27 societies that are affiliated with the Pacific Division of the association, formal meetings were held by 13, as follows:

American Chemical Society, California, Sacramento and Southern California Sections, at whose meetings the following program was presented:

Some factors controlling the basicity of amines: DALE STEWART.

Carbon monoxide, a product of electrolysis: ALBERT F. O. GERMANN.

The reactivity of liquid phosgene: ALBERT F. O. GERMANN.

The relation between adsorption and the co-precipitation of radium and barium sulphates: W. M. HOSKINS and H. A. DOERNER.

A critical study of the bisulfate fusion for rare metal ores: GEO. W. SEARS and LAWRENCE QUILL.

The activity coefficient of dilute aqueous solutions of hydrogen chloride, thallous chloride and lead nitrate: MERLE RANDALL and ALBERT P. VANSELOW.

The solubility of lead bromide in aqueous salt solutions and the principle of the ionic strength: MERLE RANDALL and WM. V. VIETTI.

The heat capacities of certain aliphatic alcohols: GEO. S. PARKS.

A source of serious error and how to avoid it, in the Scales method for determining nitrates: P. L. HIBBARD.

Soil analysis, its use and abuse: R. R. SNOWDEN.

Some organic reactions in the ammonia system: E. C. FRANKLIN.

Some chemical effects of ultra-violet light: CHAS. W. PORTER.

Anomalous conduct in the oxidation of sodium sulfite: S. W. YOUNG.

Some phases of the chemistry of the wheat berry: CARL L. ALSBERG.

Water resources of the Santa Clara valley: W. H. SLOAN.

(a) *The density and molecular complexity of gaseous hydrogen fluoride;* (b) *Attempts to prepare a fluo-carbonate and their bearing upon the coordination number of carbon:* JOEL H. HILDEBRAND and JOSEPH SIMONS.

AMERICAN METEOROLOGICAL SOCIETY

Under authorization of the council of the American Meteorological Society, at its Washington, D. C., meeting in April, 1924, a meeting of the society was held at Leland Stanford University, Palo Alto, California, June 26 and 27, 1924, in connection with the meeting of the Pacific Division of the American Association for the Advancement of Science.

Forenoon and afternoon sessions were held on June 26, and were presided over by the vice-president of the society, Dr. A. E. Douglass, University of Arizona, Tucson, Arizona, in the absence of the president, Dr. Willis Milham, Williamstown, Massachusetts. In the absence of the secretary, Dr. C. F. Brooks, Clark University, Worcester, Massachusetts, Mr. M. B. Summers, of the Weather Bureau, Seattle, Washington, was appointed secretary *pro tem.*

The following papers were read and discussed:

A study of long range forecasting for California, based on an analysis of past rainy seasons: L. E. BLOCHMAN.

Grassland as a source of rainfall: F. E. CLEMENTS.

Atmosphere and man: C. M. RICHTER.

Some features of the climate of Alaska: M. B. SUMMERS.

Classification of weather types: E. S. NICHOLS.

The climate of Portland, Oregon: EDWARD L. WELLS.

Anticyclonic weather in southern California: DEAN BLAKE.

Some climatic features of Arizona: ROBERT Q. GRANT.

Seasonal densities and storage of snow: H. F. ALPS.

Notes on the work of the weather bureau: MAJOR E. H. BOWIE.

A telegraphic abstract of a paper entitled "The economic value of climatology," by Ford A. Carpenter, of Los Angeles, California, was read in the absence of the author.

Among the resolutions adopted was one deploring the recent death of Dr. C. Leroy Meisinger, of the Weather Bureau. It follows:

Whereas, recently, in the line of duty and in an earnest effort to learn the secrets of the air and its ways, Dr. C. Leroy Meisinger, a Fellow of the American Meteorological Society, lost his life and meteorology one of its most worthy followers.

Therefore, be it resolved by the members of the American Meteorological Society, assembled at Leland Stanford University, June 26, 1924, that they do express their personal feeling of loss by reason of his untimely death, and their admiration of his efforts to contribute to our knowledge of meteorology; and, be it further resolved, that a copy of this resolution be incorporated in the minutes of the proceedings of this meeting, published in the Journal of the Society, and that a copy be sent to his nearest relative, that it may be known in what esteem he was held by members of the American Meteorological Society.

On Friday, June 27, the society met in joint sessions with the Astronomical Society of the Pacific, with W. S. Adams, of the Mount Wilson Observatory, presiding.

At this session papers were presented as follows:

The sun and atmospheric electricity: Fernando Sanford.

Atmospheric currents observed in large telescopes: A. E. Douglass.

Notes on atmospheric effects on the 100-inch telescope: Francis G. Pease.

Application of Schuster's periodogram to long rainfall records, beginning 1748: Dinsmore Alter.

American Physical Society

This society held sessions on Thursday that were well attended. The papers presented were of unusual interest, as may be judged from the titles which follow:

The growth of snowflakes: experimental evidence: John Mead Adams.

Permeability of magnetite at radio frequencies: John G. Kralovec.

The mobility of gas ions in mixtures of ammonia and air: L. B. Loeb and M. F. Ashley.

A zone-jet, multi-stage diffusion pump: E. L. Harrington.

Electrometer variations and penetrating radiation: Joseph G. Brown.

Constancy of total photo-current from sodium with temperature change 20 C. to –190 C: Robert C. Burt.

Theory of the width of the modified lines in the Compton effect: G. E. M. Jauncey.

Soft X-rays: J. A. Becker and E. L. Rose.

White light interferometer fringes: W. N. Birchby.

A new type of spectrograph: Sinclair Smith.

Secondary standards of wave-length: Harold D. Babcock.

Methods for the rapid calculation of power series formulae for band spectra: R. T. Birge and J. D. Shea.

On the simultaneous jumping of two electrons: Paul S. Epstein.

Astronomical Society of the Pacific

The Astronomical Society held two sessions on Thursday and a joint session on Friday with the Meteorological Society. On Friday night many of the astronomers and guests visited the Lick Observatory.

Papers were presented as follows:

Note on the extension to Burnham's catalogue of double stars: R. G. Aitken.

Forthcoming meridian circle publication of the Lick Observatory: R. H. Tucker.

On possible changes in the short period orbit of Polaris: J. H. Moore and E. A. Kholodovaky.

Do the star streams of Kapteyn exist? C. V. L. Charlier.

Preliminary results from the investigation of the orbit of Comet B1922 (Skjellerup): R. T. Crawford and W. F. Meyer.

The number of solutions in Leuschner's direct method for determining the orbits of disturbed bodies: R. H. Sciobereti.

The total solar eclipse of September 10, 1923: A. E. Douglass.

Society of American Foresters, California Section

The joint session of the Society of American Foresters, California Section, with the Ecological Society, was largely dominated by discussions concerning the coming forest. S. B. Show pointed out the difficulties growing from the deliberate attempts to influence the composition of the growing stand through forest management and their relation to ecological principles. The same author, in a second paper, discussed the changes brought about by fires in the California pine forest from transitory brush fields to the reestablishment of a permanent stand different in type and composition from the original. The data presented by J. M. Miller tended to show that the rate of loss from bark beetles in thrifty mature overholders left standing in logging operations is alarmingly high. E. P. Meinecke demonstrated that the logical basis for the evaluation of loss in the young forest from killing diseases such as the white pine blister rust is not the percentage of trees killed but the effect of the killing on the density of the coming stand. *Cronartium pyriforme* was used as an illustration. In a second paper the same author endeavored to establish the physiological background for economic studies of excessive foliage reduction due to defoliating insects and to foliage diseases of fungous origin. Carl L. Alsberg suggested that theoretically the production from plant growth should be greater on a given surveyor's unit of slope than on the same unit of level land. A paper by R. W. Doane gave contributions to the life history and habits of western Ambrosia beetles with special reference to the cultivation and utilization of the Ambrosia mycelium.

Following is a list of papers presented:

Fire as an ecological factor in the pine forests of California: S. B. Show.

The management of forest properties in the California pine region as a problem in applied ecology: S. B. Show.

Excessive foliage reduction in evergreen coniferous forests: E. P. Meinecke.

The evaluation of loss from killing diseases in the young forest: E. P. Meinecke.

Some considerations on the relation between topography and density of vegetation: Carl L. Alsberg.

Notes on some western Ambrosia beetles: R. W. Doane.

Some entomological factors affecting future forests: J. M. Miller.

The Ecological Society of America

The joint symposium with the Western Society of Naturalists, on the morning of June 26, focussed attention upon plant and animal life of chaparral and broad-leaved forest and of grassland in California. Dr. Frank J. Smiley, speaking on chaparral vegetation as developed in southern California, brought out its unique floristic character and its considerable age. Dr. F. E. Clements's paper on native grassland characterized it as more extensive than any other vegetation-type and as well suited to the climatic condition of winter rainfall. Its relation to the grasslands of Arizona and of the prairie region from Miocene time to the present was indicated. These papers and the discussion made it appear that there has not been a recent tendency, due to clearing and other human factors, for grassland to extend its area at the expense of chaparral.

The two papers on the animal life were to bring out the substantial agreement of animals and plants in their response to environmental factors. The unavoidable absence of Dr. J. Grinnell prevented the reading of his paper on vertebrate animals. Dr. E. C. Van Dyke demonstrated that the insect populations of chaparral, broad-leaved forest and open grassland are strikingly different, due in part to direct relations to food plants.

The afternoon meeting with the Society of American Foresters is described in the report for that organization.

On Friday morning, a joint session with the Western Society of Naturalists was held. It is described in the report for that society.

In the Friday afternoon session of the Ecological Society, A. B. Rigg described some sphagnum bogs of the Coos Bay region of Oregon. J. M. Harper, in an account of soil-moisture in the vicinity of Palo Alto, pointed out consistent differences between the coarse soils of chaparral areas and the fine soils of grassland. A. G. Vestal reported on root relations of some California grassland plants. Forrest Shreve gave instances of the workings of depth, slope exposure, color and other factors which determine the temperature of the soil. G. P. Rixford described experiments in growing certain tropical and semi-tropical fruits in favorable situations in California. The cherimoya, sapote blanco, jujube and others seem worthy of trial.

The dinner for biologists on Friday evening was held at the Stanford Union. The field trip to the coast on Saturday was of great interest to members of the Ecological Society.

Following is the full program presented:

Symposium: Vegetation and the Associated Animal Life in West-Central California

Joint session with the Western Society of Naturalists

Chaparral and broad-leaved forest vegetation of the southern coast range: Frank J. Smiley.

Native grasslands and their significance: Frederic E. Clements.

Vertebrate animal life in relation to the plant environment: J. Grinnell.

Insect life in relation to the plant environment: Edwin C. Van Dyke.

Bird banding as a means in ecological studies: J. E. Law.

Mutations and the origin of species: David Starr Jordan.

An excursion to the great barrier reef of Australia: W. E. Ritter.

Gravity as a formative stimulus in plants: G. J. Peirce.

Mentioning the mole: T. H. Scheffer.

Notes on the breeding of beavers: T. H. Scheffer.

The age of the oaks of the Santa Clara valley: James I. W. McMurphy.

Color studies of lizards: Sarah R. Atsatt.

The hay-field tarweeds: An application of genetic, ecologic and quantitative methods to the taxonomy of a complex species: H. M. Hall.

Anomalies in the distribution of gulls in California Pleistocene: L. H. Miller.

The fossil geese of the genus Branta: L. H. Miller.

Sphagnum bogs of the Coos Bay region of Oregon: George B. Rigg.

Soil moisture in grassland areas near Palo Alto: J. M. Harper.

Root relations of some California grassland plants: A. G. Vestal.

Factors influencing the temperature of the soil: Forrest Shreve.

Society for Experimental Biology and Medicine, Pacific Coast Branch

This society held one session Wednesday afternoon, with the following program:

The effect of fine grinding upon starch: C. L. Alsberg.

Study on the manner in which the toxin of Clostridium botulinium acts upon the body. III. Further investigations of the curves of fatigue in the muscles supplied by the voluntary nervous system: E. C. Dickson and V. E. Hall.

The effect of stenosis upon the respiration during exercise: A. W. Hewlett, J. K. Lewis and Anna Franklin.

The effect of cooling on the excitability of nerve and muscle: E. G. Martin.

Further evidence of the rôle of the hepatic internal secretion in canine anaphylaxis: W. H. Manwaring.

A new insulin fraction which is active orally when given in water solution: W. D. Sansum.

Diet and parathyroid tetany: T. Inouye (Introduced by Dr. Geo. R. Cowgill.)

Regulation of the hydrogen ion concentration and its relation to metabolism and respiration in the starfish: Laurence Irving (introduced by E. G. Martin).

The carbonic acid-carbonate equilibrium in sea water, with special reference to respiration: Laurence Irving (Introduced by E. G. Martin).

On Wednesday evening the society had an informal dinner at the Stanford Union.

Pacific Coast Entomological Society

The ninety-fourth meeting of the society was held at Stanford University on June 25, 1924.

The morning session was called to order by President E. D. Van Dyke at 10:30 o'clock, in Room 430 of the Zoology-Entomology Building. There were 28 members and 12 non-members present. Six papers were presented as a symposium on the entomological activities on the Pacific Coast.

The afternoon session was called to order at 4 o'clock and 11 talks were given by visiting entomologists and members. Dr. L. O. Howard presented the greetings of the Entomological Society of Washington and Mr. W. M. Giffard the greetings of the officers and members of the Hawaiian Entomological Society.

American Association of Economic Entomologists, Pacific Coast Branch

This society held formal sessions Thursday and Friday forenoon and afternoon, with papers as follows:

Some habits of the California lead cable borer: H. E. Burke. (Illustrated.)

The garden centipede (Scutigerella immaculata Newp.): F. H. Wymore. (Illustrated.)

Notes on an outbreak of cutworms: S. J. Snow.

Cylindrocopturus jatrophae, a new economic pest: Charles T. Vorhies.

Forest insect control: H. E. Burke.

Malaria: George E. Stone.

Arsenical residue and codling moth control: E. R. de Ong.

Experiments on the efficacy of lead arsenate in protecting apples against codling moth injury: Ralph H. Smith. (Illustrated.)

Studies of parasites of the alfalfa weevil in Europe: T. R. Chamberlin.

The tule bill bug (Calandra discolor Man.). W. B. Turner. (Read by C. M. Packard.)

The effect of weevily beans on the bean crop and upon the dissemination of the weevils, B. obtectus and B. quadrimaculatus: A. O. Larson.

The possibilities of weevil development in neglected seeds in warehouses: C. K. Fisher.

Insects in cereal food products: R. W. Doane.

The life history and biology of Echocerus cornuta: David Shepherd.

The thurberia boll weevil and thurberia boll worm problem in Arizona: Charles T. Vorhies.

Lygus elisus on cotton in the Pacific region: E. A. McGregor.

Calcium cyanide as a soil fumigant for wireworms: Roy E. Campbell.

The citrophilus mealy bug as a pest of citrus: H. M. Armitage.

Facts concerning fluctuation in numbers of beet leafhopper in a natural breeding area in the San Joaquin valley in California: H. H. Severin.

Unique features of the program of this very active society were the first annual Pacific Coast championship ball game, played on the Faculty Club House Diamond, Friday afternoon, between the federal entomologists and the state entomologists. It is said the score stands 22 to 0 in favor of the state entomologists.

Following the conclusion of this arduous struggle the participants and their guests took part in an old-fashioned barbecue at the Faculty Club.

The meeting was probably the best the Pacific Coast branch has ever held, being notable both for the large attendance, which exceeded any previous meeting, and the number of distinguished entomologists present. Much benefit and pleasure were derived from the presence of these visiting members. Nineteen interesting and instructive papers were presented, together with two motion pictures on insect control. Newly elected officers are: *Chairman,* Leroy Childs; *vice-chairman,* Stanley Freeborn. The secretary is Roy E. Campbell.

Seismological Society of America

This society held one session Friday morning with the following program:

Origin of the earthquake forces in California: Bailey Willis.

An absolute seismograph: Paul Kirkpatrick.

The torsion seismometer: J. A. Anderson and H. O. Wood.

Some experiments with Milne-Shaw seismographs: E. A. Hodgson.

Botanical Society of America, Pacific Division of Plant Physiological Section

Sessions were held on Friday forenoon and afternoon with the following program:

Gravity as a formative stimulus: G. J. Peirce.

Experiments in bud correlation: F. E. Clements.

A study of the conductive tissues in the stems of Bartlett pear, and the relationship of food movement to dominance of the apical buds: F. E. Gardner.

Are cambial activity and food reserve correlated? E. L. Proebsting.

Root growth in the cotton in relation to the oxygen supply and to temperature: W. A. Cannon.

Physiological conditions in sphagnum bogs of the northwest coast: G. B. Rigg.

The molecular structure of the cell wall: O. L. Sponsler.

Some remarks of the absorption of ions and the energy relations involved: D. R. Hoagland and A. R. Davis.

An apparatus for the growth of plants in a controlled environment: A. R. Davis and D. R. Hoagland.

The influence of potassium in the culture solution upon the formation of diastase by wheat: A. R. Davis and J. L. Doughty.

The absorption of ions by plants in light and in darkness: A. R. Davis and O. E. Nay.

Combinations of single salt solutions as culture media for the growth of wheat: L. J. H. Teakle.

Observations on growth of plants with continual renewal of culture solutions: L. J. H. Teakle.

Western Society of Naturalists

The meetings were held at Stanford University on June 26 and 27. A symposium with the Ecological Society was held on Thursday morning; on Thursday afternoon there was a session for the reading of papers, and on Friday morning a joint meeting. In addition to the papers listed in the symposium on vegetation and the associated animal life in west-central California, in joint session with the Ecological Society of America, the following papers were presented:

The whales of the California coast: Barton Warren Evermann.

The Pan-Pacific Union food conservation congress to be held at Honolulu in August: Barton Warren Evermann.

Effect of gestation and lactation on activity and food consumption: J. R. Slonaker.

Effect of compulsory work during gestation on mother and young: J. R. Slonaker.

Motor deficiency effects in the guinea pig: A. W. Meyer.

Thyroxin as a depressor of cell division: H. B. Torrey.

Thyroxin as an accelerator of pigment: H. B. Torrey.

A remarkable development of the sporophyte in anthoceros: D. H. Campbell.

Notes on life history of Ascarida perspicillum (Rud.): J. E. Guberlet.

Mitosis in endamoeba dysenteriae: C. A. Kofoid and Olive Swezy.

Inheritance of reversal of geotropic response: E. B. Babcock.

The influence of pituitary gland removal on development of rana: B. M. Allen.

Ciliary currents in starfish: Laurence Irving.

Multiple allelomorphs in the silkworm: Isabel McCracken.

Exhibition of the hybrid Xiphophorus helleri × *Platypœcilus rubra:* Isabel McCracken.

Progeny of species hybrids in crepis: Margaret Mann.

On Friday evening, the Western Society of Naturalists and Ecological Society gave a dinner in the Stanford Union, and on Saturday the members of the two societies and their friends went on a field trip to La Honda, Moss Beach and other points of zoological, botanical and ecological interest in the Santa Cruz mountains and along the seashore.

The following officers were elected for the next year: *President,* Nathan Fasten, Oregon Agricultural College, Corvallis; *Vice-president,* H. M. Hall, Carnegie Institution of Washington, University of California, Berkeley; *Secretary-treasurer,* C. O. Esterly, Occidental College, Los Angeles, California; *Members of Executive Committee,* H. B. Torrey, University of Oregon, Eugene, and G. B. Rigg, University of Washington, Seattle.

While the Pacific Division of the American Phytopathological Society, the California Academy of Sciences, the Cooper Ornithological Club, the Lorquin Natural History Club, the Pacific Fisheries Society, the Sierra Club, the Utah Academy of Sciences and certain other affiliated societies did not hold separate sessions, their members contributed to the programs of various other societies.

Officers of the Pacific Division of the American Association for the Advancement of Science for 1924–25

President—C. E. Grunsky, president of the California Academy of Sciences, and president of the American Society of Civil Engineers, 57 Post Street, San Francisco, California.

Vice-president and Chairman of the Executive Committee—Joel H. Hildebrand, professor of chemistry, University of California, Berkeley, California.

Members of the Executive Committee—Walter S. Adams, director, Mount Wilson Observatory, Pasadena, California (1928); Robert G. Aitken, associate director, Lick Observatory, Mount Hamilton, California (1927); Bernard Benfield, consulting engineer, Kohl Building, San Francisco, California (1929); William M. Dehn, professor of chemistry, University of Washington, Seattle, Washington (1925); Harvey M. Hall, Carnegie Institution of Washington, 1615 Loma Avenue, Berkeley, California (1926); Ernest G. Martin, professor of physiology, Stanford University, California (1929); Emmet G. Rixford, professor of surgery, Stanford University, 1795 California Street, San Francisco, California (1928).

The place and time of the 1925 meeting of the Pacific Division have not been determined further than that the meeting will be held either at Eugene or Portland, Oregon, sometime in June.

Barton Warren Evermann,
Acting Secretary

SCIENCE

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PREVENTION OF DISEASE[1]

My first duty is to thank the general committee of the British Association for the great honor they have done me by electing me to the post of president. I must confess I wondered at first why I had been chosen, but soon came to the conclusion that it was an honor done through me to all army medical officers for the magnificent work done by them during the great war in the prevention of disease and alleviation of pain and suffering.

In the next place, I may be permitted to remind you that this is the fourth time the British Association for the Advancement of Science has met in Canada—first in 1884 in Montreal, in this city in 1897, and in Winnipeg in 1909. The addresses given on these occasions dealt with the advancement of knowledge in archeology and physics.

It is now my privilege, as a member of the medical profession, to address you on the advances made during the same period in our knowledge of disease and our means of coping with and preventing it.

An address on the prevention of disease at first sight does not promise to be a very pleasant subject, but, after all, it is a humane subject, and also a most important subject, as few things can conduce more to human happiness and human efficiency than the advancement of knowledge in the prevention of disease.

Think for a moment of the enormous loss of power in a community through sickness. Some little time ago the English Minister of Health, when emphasizing the importance of preventive work, said that upwards of 20,000,000 weeks of work were lost every year through sickness among insured workers in England. In other words, the equivalent of the work of 375,000 people for the whole year had been lost to the state. When to that is added the corresponding figure for the non-insured population you get some idea of the importance of preventive work.

Another way of estimating the value of prevention is in terms of dollars, or pounds, shillings and pence, and it has lately been calculated that the direct loss in England and Wales from sickness and disability amounts to at least £150,000,000 a year. In the United States, with a much larger population, the loss is put down at £600,000,000.

Another reason why this is an important subject is that medicine in the future must change its strategy, and instead of awaiting attack must assume the offensive. Instead of remaining quietly in the dressing

[1] Address of the president at the meeting of the British Association for the Advancement of Science, Toronto, Canada, August 6, 1924.

stations and field hospitals waiting for the wounded to pour in, the scientific services must be well forward in the enemy's country, destroying lines of communication, aerodromes, munition factories and poison-gas centers, so that the main body of the army may march forward in safety.

It must no longer be said that the man was so sick he had to send for the doctor. The medical practitioner of the future must frequently examine the man while he is apparently well, in order to detect any incipient departure from the normal, and to teach and urge modes of living conformable to the laws of personal health, and the public health authorities must see to it that the man's environment is in accordance with scientific teaching.

It may be a long time before the change is widely accepted, but already enormous advances have been effected, and it only depends on the intelligence and education of the populations how rapid the future progress will be. Public opinion must be educated to recognize that most diseases are preventable and to say with King Edward VII, "If preventable, why not prevented?"

To our forefathers disease appeared as the work of evil spirts or magicians, or as a visitation of Providence to punish the individual or the community for their sins.

It is not my purpose to give a detailed account of the first strivings after a better knowledge of the causes of disease, but it may be said the new era began some few hundred years ago, when it was recognized that certain diseases were contagious. For a long time it was held that this contagion or infection was due to some chemical substance passing from the sick to the healthy and acting like a ferment; and then, about the middle of last century, the idea gradually grew that microscopic creatures might be the cause. About this time it had been discovered that the fermentation of grape juice was caused by a living cell and that certain contagious skin diseases were associated with living fungi.

Things were in this position when there appeared on the scene a man whose genius was destined to change the whole aspect of medicine; a man destined to take medicine out of the region of vague speculation and empiricism and set its feet firmly on new ground as an experimental biological science. I mean the Frenchman, Louis Pasteur. It is from him we date the beginning of the intelligent, purposive prevention of disease. It was he who established the germ theory and later pointed the way to the immunization of man and animals, which has since proved so fruitful in measures for the prevention or stamping out of infectious diseases.

I need not discuss his life and work further. His name is a household word among all educated and civilized peoples. Every great city should put up a statue to him, to remind the rising generations of one of the greatest benefactors of the human race.

What the change in medicine has been is put into eloquent language by Sir Clifford Allbutt:

> At this moment it is revealed that medicine has come to a new birth. What is, then, this new birth, this revolution in medicine? It is nothing less than its enlargement from an art of observation and empiricism to an applied science founded upon research; from a craft of tradition and sagacity to an applied science of analysis and law; from a descriptive code of surface phenomena to the discovery of deeper affinities; from a set of rules and axioms of quality to measurements of quantity.

With one notable exception, the medical profession was not quick to see that Pasteur's discoveries of the nature of fermentation and putrefaction had a message for them. This exception was Joseph Lister, who had been for some years endeavoring to comprehend the cause of sepsis and suppuration, which commonly followed every surgical operation and most serious injuries involving a breach of the skin.

When, in 1865, Lister read Pasteur's communication upon fermentation, the bearing of the discovery on the problems which had so earnestly engaged his attention was apparent to him. He inferred that suppuration and hospital gangrene, the causes of which had so far baffled his imagination, were due to microbes introduced from the outside world, from the air and by instruments and hands of the operator. Remember, this was years before the microbial causation of any disease was established.

To test the correctness of his inference, Lister proceeded to submit all instruments, ligatures, materials for dressing and everything that was to come directly or indirectly into contact with the wound, the hands of the operator and the skin of the patient to treatment with chemical disinfectants. The satisfactory results which followed this practice astonished even Lister, and he spent the rest of his active life in improving and simplifying technical methods of preventing the ingress of microbes to wounds and in convincing his professional brethren of the truth of the conclusions based on this work of Pasteur.

INFECTIOUS DISEASES—(A) BACTERIAL

As soon as it was recognized that infectious diseases are caused by living germs a wave of enthusiasm swept through the medical world, and it was not long before the causation of many of the most important of them was discovered. I need not give a full list of these, but at or around about the time of the first meeting of the British Association in Canada the micro-organisms of tuberculosis, typhoid fever, Malta fever, cholera, malaria, diphtheria, tetanus and others had been discovered and described.

But it must not be assumed from what has been said that all the most important diseases are caused by living germs. Many of the ills that afflict mankind are due to quite other causes—alcoholism, for example, or the deficiency diseases, due to the absence or deficiency in our diet of some substance essential to proper growth and development. Rickets, one of the greatest scourges of industrial communities, is mainly a deficiency disease. It is reported that as many as 50 per cent. of the children in the slums of some of our big cities suffer from the effects of this disease.

Then, again, there is the whole series of diseases or conditions due to defective or excessive action of our own internal glands. Added to these, and perhaps the greatest scourge of all, there is the immense amount of chronic ill health and actual disease caused or promoted by the unhealthy conditions found in our large cities, due to bad housing and overcrowding—the so-called diseases of environment.

Malta Fever

But to return to the infectious diseases. After the living germs or parasites causing them had been isolated the process of prevention was soon begun. The methods employed were varied, and I may illustrate one of the simplest by relating briefly the history of the prevention of Maltà fever, with which I was myself, to some extent, associated.

Malta fever is really a widespread disease, although it is called by a local name. It is found all round the Mediterranean, throughout Africa as far south as Cape Province, in India and China and even in some parts of America. It was very prevalent in Malta in the old days, and rendered the island one of the most unhealthy of all our foreign military stations. When I arrived in Malta, in 1884, I found that every year, on the average, some 650 soldiers and sailors fell victims to it, and, as each man remained on an average 120 days in hospital, this gave the huge total of about 80,000 days of illness per annum from this fever alone.

The British had held Malta since the beginning of the last century, and, although much attention had been given to the fever and its symptoms had been fully described, no advance was made towards its prevention until 1887, when the living germ, the *Micrococcus melitensis,* causing it was discovered. At this time a good deal of work was expended in studying the natural history of the fever and the micrococcus, but all to no purpose. Nothing was discovered to give a clue to any method of prevention.

At the Naval Hospital especially everything in the way of prevention was done that could be thought of: the water supply and drainage were thoroughly tested, the walls were scraped and every corner rounded off where dust might lie, immaculate cleanliness reigned; but all these precautions proved useless. Almost every sailor who came into the hospital even for the most trivial complaint took Malta fever, and after a long illness had to be invalided to England.

Things remained in this very unsatisfactory state for seventeen years, until 1904, when the Admiralty and War Office, alarmed at the amount of sickness and invaliding in the Malta garrison, asked the Royal Society of London to undertake the investigation of the fever. This was agreed to, and a commission was accordingly sent out in the same year and remained at work until 1906.

During the first year every likely line of approach was tried. A careful study was made as to how the micrococcus entered the body, how it left the body, its behavior outside the body, its pathogenic action on various animals; but still no indication of a method of prevention showed itself. Next year, however, in 1905, the problem of prevention was solved, and that by the merest of accidents.

In the previous year experiments had been made with the object of finding out if the goat, among other animals, was susceptible to the disease. The goats in Malta, which supply all the milk, are very much in evidence, as they are driven about in small herds and milked as required at the doors of customers. Several goats had been injected with cultures of the micrococcus, but, as they showed no rise of temperature or any signs whatever of ill health, they were put aside as being immune or refractory to the disease and nothing more was thought about them.

In the spring of 1905, about six months after these experiments had been made, Dr. Zammit, a Maltese member of the commission, who had kept one or two of these goats, happened for some reason or other to examine their blood and found that it clumped or agglutinated the micrococcus. This was strange and seemed to show that, although the micrococcus had not caused fever or any signs of illness in the goats, it must have lived and multiplied in the tissues of these animals in order to have brought about this change in the blood.

This observation led to the reexamination of the goat question, when the extraordinary discovery was made that about 50 per cent. of the goats in the island were affected by this disease, and that 10 per cent. of them were actually excreting the micrococcus of Malta fever in their milk. Monkeys fed on milk from an affected goat, even for one day, almost invariably took the disease.

Thus the weak link in the chain of causation had been found. The military authorities struck Maltese milk out of the dietary, and replaced it by an imported variety, and from that day to this there has scarcely been a case of Malta fever in the garrison. Malta, from being the most unhealthy of foreign sta-

tions, became a health resort, and was in fact used as a sanatorium during the late war. The disease had been blotted out at a single blow.

This, then, is one way of preventing an infectious disease; that is to say, by the discovery of the living germ, the study of its natural history, and so to a means of stopping it reaching its victim, man. This is the best way of prevention: shutting the stable door before the horse is stolen.

Typhoid Fever

But there are other ways of preventing bacterial diseases. Let us take, for example, a method widely used in the prevention of typhoid fever.

The fundamental and sound way of attacking this disease is by ordinary hygienic measures, especially a good water supply and good drainage. It is therefore one of the first duties of those in power to see that their people have, in addition to houses with plenty of light and air, a good water supply and a good drainage system, and money can not be spent to better advantage than in the attainment of these three essentials to health.

When typhoid fever is rife in a community it means that there is either a contaminated water supply or a faulty drainage system, and the municipal authorities ought to be called to account. In England, owing to improved sanitation, cases of typhoid fever are fifteen times less than they were fifty years ago. But it is not always possible to ensure good hygienic surroundings, for example, among troops on active service. It is therefore legitimate under certain conditions, and especially in time of war, to practice a less sound, a less fundamental, method of prevention, and this second method is known as inoculation or vaccination.

In order to understand how this acts, let us consider for a moment what takes place in a man's body when he is attacked by the typhoid bacillus. Everybody knows that the bacillus gives rise to poisons or toxins which cause the fever and other symptoms. But the cells and tissues of the man are not passive under the attack. They at once begin to fight against the infection, by forming substances in the blood to neutralize these toxins, hence called antitoxins or antibodies, and their function is finally to destroy the invading germs. If the man recovers he is immune from a further attack by the presence of these antibodies in his blood. He has become immune by passing through an attack of the disease.

This is the foundation of the second way of preventing infectious diseases. Speaking broadly, it means that you subject a man to a mild attack of the fever in order that his blood and tissues will respond to the stimulus by producing antibodies. This method takes its origin and name from that of vaccination against smallpox. Jenner solved that problem by the accidental discovery of vaccinia, a form of smallpox attenuated or weakened by passage through another species of animal. This weakening of the virulence of a microorganism by passage through another kind of animal is by no means uncommon in nature.

Pasteur, following on these lines, conceived the idea of weakening or attenuating the virulence of the living bacilli by artificial means, so as to give rise to a mild attack of the disease, and so in this way to render animals immune. This he did with marked success in anthrax and chicken cholera. The next forward step in this method of preventing disease was made by Haffkine, a pupil of Pasteur, who about the year 1894 produced a vaccine against cholera and a few years later another against plague. In the course of this work it was discovered that it was not necessary to use living cultures of the bacilli, but that vaccines made up of dead bacilli had much the same effect. This substitution of the dead bacilli for the living was a great advance in this method, being much simpler and much safer.

The next disease to be attacked by this method was typhoid fever. This was initiated by Sir Almroth Wright at the British Army Medical School and carried out with that scientist's characteristic ability and energy. The method was mainly directed in the first place to lessen the mortality from this disease among our soldiers serving in India.

After several years' experience, the mode of inoculation which was finally settled on was to give two injections of dead typhoid bacilli, one of five hundred millions, and a second, at an interval of ten days, of a thousand millions.

Now let us see what effect anti-typhoid inoculation has had on the prevention of typhoid fever among our soldiers in the field. In the South African War, at the beginning of the century, before the method had been developed, in an army the average strength of which was only 208,000 there were 58,000 cases of typhoid fever and 8,000 deaths. In the Great War, on the Western front, with an average British strength of one and a quarter millions, there were only 7,500 cases and 266 deaths. In other words, there were fewer cases of the disease in this war than there were deaths in the South African. It is also interesting to learn from French sources that at the beginning of the war the French soldiers were not inoculated, whereas the British were. The result for the first sixteen months was striking. During this time the French had some 96,000 cases, with nearly 12,000 deaths. The British had only 2,689 cases and 170 deaths. Afterwards the French soldiers were very thoroughly vaccinated, with the result that their immunity eventually became as striking as our own.

What the number of cases and death-rate from typhoid fever might have been in the huge armies

fighting on the different fronts had it not been for this preventive inoculation is impossible to say, but undoubtedly the suffering and loss of life would have been enormous. I may therefore conclude this account of anti-typhoid inoculation by saying that it certainly constituted one of the greatest triumphs in the prevention of disease during the recent war.

Tetanus and Diphtheria

I shall now pass on to consider a third method of preventing bacterial diseases which has also been evolved during the time under review; that is, by the injection of specially prepared blood sera. These are known as antitoxic sera, and the most familiar examples are antitetanic and antidiphtheritic. We have seen how the injection of living or dead bacilli or their toxins into animals gives rise to the production of antibodies or antitoxins. The blood serum of such animals in virtue of the antibodies contained in it can be used to combat disease.

Let us take in the first place the case of tetanus, until recently considered to be one of the most fatal of maladies, at least 85 per cent. of the cases succumbing. As you are aware, antitetanic serum is prepared by injecting horses with large quantities of tetanus toxin. When the blood is as full as possible of antibodies it is drawn off and the serum allowed to separate out.

The idea lying behind this third method of preventing disease is to pour in these ready-made antitoxins in order to assist the body in its first struggle with the invading disease, and give it, as it were, a breathing space to prepare its own defences.

Naturally the immunity produced by these antitoxic sera is of a passive nature and of short duration, as compared with that produced by the disease itself or even by the milder form brought about by vaccination or inoculation. Antityphoid inoculation will protect a soldier for, let us say, two years; antitetanic serum will only protect for a week or ten days. It is therefore impossible to inoculate a whole army against tetanus. It is necessary to wait until there is a danger of the disease occurring.

To illustrate this I shall describe briefly the history of the prevention of tetanus during the Great War. When the British Expeditionary Force went over to France, in August, 1914, only a small quantity of antitetanic serum was taken and that for the purpose of treatment rather than prevention. But shortly after the outbreak of hostilities the number of cases of tetanus among the wounded became so alarming that no time was lost in grappling with the danger. Large quantities of serum were hurried to the front, and some two months after the beginning of the war it was possible to make an order that every wounded man should receive an injection of antitetanic serum as soon after he was wounded as possible. Later on, after further experience had been gained, the single injection was increased to four, given at intervals of a week. This helped the wounded man over the dangerous time and the results were very successful.

In August and September, 1914, before the prophylactic injection was given, roughly speaking nine or ten out of every thousand wounded were attacked by tetanus and some 85 per cent. of these died. After the antitetanic injections had been introduced the incidence fell to little more than one per thousand and the mortality to less than half. To put the matter broadly: during the war there were 2,500 cases of tetanus in the British Army, with 550 deaths. If there had been no prophylactic injection of antitetanic serum there would probably have been 25,000 cases with 20,000 deaths— a very striking example of the recent development in the prevention of disease.

Another very important and widespread disease, somewhat resembling tetanus, is diphtheria, and there is no better example of the advance of science in methods of cure and prevention than is found in this disease. Thanks to the work of Klebs and Löffler in the early eighties and, some years later, to the brilliant researches of Roux and Yersin, the causation and natural history of this disease were very thoroughly elucidated.

Antidiphtheritic serum is prepared much in the same way as the antitetanic. By the repeated injections of gradually increasing doses of the bacilli or their toxins, a serum is produced which has a marked curative effect in cases of diphtheria. It is stated that the introduction of antidiphtheritic serum in 1894 has reduced the death-rate from 40 to 10 per cent. and if used on the first day of the disease to almost *nil*. The serum is essentially a curative agent and is useful only to a limited extent in prevention.

But lately essentially preventive measures in diphtheria have come into vogue. The procedure employed is to bring about an active immunization by a mixture of toxin and antitoxin in individuals who have been shown to be susceptible to the disease by what is known as the Schick test. In the United States a campaign on these lines has been begun against this disease which promises brilliant results. It is confidently stated that by their new measures there is a possibility of robbing diphtheria of all its powers to kill and injure.

The mode of prevention of these diseases—Malta fever, typhoid fever and tetanus—illustrates the three principal methods of preventing bacterial diseases: In Malta fever, by getting down to bed-rock and stopping the disease at its source; in typhoid fever, by giving, as it were, a mild attack of the disease, by vaccination or inoculation, so as to bring about a greater power of resistance; in tetanus, by pouring

in antitoxins, already prepared in the serum of another animal, in order that they may neutralize the toxins of the invading bacilli as soon as they are formed.

Tuberculosis

There are other important bacterial diseases, however, which can not be attacked so simply. For example, there is tuberculosis, a disease distributed over the whole world and one of the greatest scourges of civilized communities. It is a disease which has been known from time immemorial, but it is only within our own time that the bacterial cause has been recognized. I can well remember a day in 1882, when I met a fellow-student who had just returned to Edinburgh from Germany. He told me that it had been recently discovered that the disease was really caused by a living germ, the tubercle bacillus. It was difficult at first to believe such a revolutionary idea, but such was the interest and excitement raised that many workers at once took up the study of the subject and in a short time the truth of Koch's great discovery was fully proved. This was a magnificent example of research work, most admirably, carefully and completely carried out, and placed Koch at once in the front rank of scientific workers.

Before Koch's discovery a good deal had been done in the way of prevention. Before all things, this disease is a disease of environment. Its birthplace and home is the sunless, ill-ventilated, overcrowded room. The late Professor Edmund Parkes, professor of hygiene at the Army Medical School, reduced to a great extent the incidence of tuberculosis in the British Army by procuring for the soldier more floor-space and more air-space in his barracks. It is related of General von Moltke that when he heard of the death of Parkes he said that every regiment in Europe should parade on the day of his funeral and present arms in honor of one of the greatest friends the soldier ever had.

The prevention of tuberculosis is thus seen to depend fundamentally on the provision of a better environment and the education of the people in physiological living. To attain this in the older civilizations will be a hard task, entailing enormous expenditure of money and energy. In the report of the Royal Commission on the Housing of the Industrial Population of Scotland in 1917 is described the unsatisfactory sites of houses and villages, insufficient supplies of water, unsatisfactory provision for drainage, the gross overcrowding in the congested industrial towns, occupation of one-room houses by large families, groups of lightless and unventilated houses in the older burghs, clotted masses of slums in the great cities—a terrible picture, the heritage of the age of ignorance, internal strife and walled towns.

The people of new countries should see to it, and doubtless will see to it, that these old evils are not perpetuated. As Sir Robert Philip, professor of tuberculosis in the University of Edinburgh, has eloquently said:

> Were it possible to begin afresh the scheme of civilized life, were it possible to undertake anew the creation of cities and the homes of our people, were it possible to place within the recreated dwellings an understanding race, detuberculization might be quickly attained. What a magnificent opportunity for the builders of the new cities, the moulders of fresh civilizations, with the grand purpose of "No tuberculosis." The architect, the sanitarian and the citizen would agree in insisting that physiological laws should be paramount, that there should be effective obedience to the larger demands of hygiene in the home, the school, the workshop, the meeting-place and the cow-shed.
>
> Mankind was born into air and sunlight: these are his natural heritage. They are more—they are the irreducible conditions of life.

In regard to the tubercle bacillus, it is so widespread, so ubiquitous in civilized communities, passing from one infected host to infect another, that it would seem impossible under existing conditions to prevent its spread. At present it is taught, and on what seems good evidence, that the majority of the population of our crowded cities has at one time or another been attacked by this disease. But in every hundred men who die in England, only about ten die of tuberculosis, which shows that a large percentage of the population successfully resists the tubercle bacillus. When this occurs it means that the person attacked possessed powers of resistance which enabled him either to destroy its invading bacilli or to otherwise deal with them so as to render them harmless.

A point of importance in this connection is that it has recently been demonstrated that the disease is usually acquired in childhood. The fact is of capital significance, for, if the disease is recognized sufficiently early and the child is placed under good hygienic conditions, there is a very good chance of effective resistance and immunity against a second attack being set up. The present evidence goes to show that the presence of a latent tubercle prevents a second invasion. If further outbreaks take place, they would seem to be due to a flaring up of the old latent tubercle rather than to a fresh infection.

Metchnikoff studied the question in a remote part of Siberia where the tubercle bacillus was unknown. He states that very many of the young men and women who migrated from this clean country into the big cities died of acute and rapid tuberculosis, on account of not having been exposed to infection in their childhood.

The experience of Colonial troops in the late war

is instructive. Thus, in France the Senegalese, who are almost without tuberculosis in their native condition and were found to be free from tuberculosis on reaching France, developed in large numbers an acute and fatal form of tuberculosis in spite of the hygienic measures enforced by the army authorities. This raises a curious point. If it were possible for any country to clear itself of the tubercle bacillus, it would appear to be incurring a great risk for an inhabitant to migrate into any neighboring country. But, in spite of this, it is the duty of medical men to keep in check, as far as possible, the ravages of the disease.

The preventive measures against tuberculosis at the present time are, in the first place, improvement in the general hygienic conditions. Thereby individual resistance—and communal resistance—can be remarkably increased. In the second place, as every case of tuberculosis must arise from a previous case, either human or bovine, it is very necessary that methods of early diagnosis, preventive treatment and segregation of the more infective types may be provided for. This is done by the setting up of tuberculosis dispensaries, care committees, sanatoria, hospitals and colonies. These several elements are combined in the model tuberculosis scheme which is now universal throughout Great Britain. In the third place, if much can be done to anticipate and limit the progress of infection by the use of tuberculin, much caution is required in assessing the claims, sometimes hasty and extravagant, advanced by adventurers in this field ot research.

Many other points might be brought forward, but the subject is such a vast one that I must content myself with drawing attention to the importance of a sound milk supply. The contamination of our home herds with tuberculosis is so great that no pains should be spared to secure a safe milk supply, and I understand that the city of Toronto is a model in this respect.

The result of these methods of prevention against tuberculosis may be given briefly. Sir Robert Philip writes that in Scotland ten years before Koch's discovery the death-rate from this disease was 404 per 100,000; in 1920 it had fallen to 124 per 100,000, a fall of 69.3 per cent. He also points out that the

> recent acceleration of rate of reduction which is noticeable in England and Scotland is of arresting interest.
>
> In Scotland the acceleration of fall in the mortality rate likewise arrests attention. Thus, during twenty years up to 1890, the percentage fall in mortality from all forms of tuberculosis was 35, while during twenty years from 1900–1919 the percentage fall was 45.

This is very satisfactory, and has only been arrived at by hard work on the part of medical men, nurses and voluntary workers. Any tuberculosis scheme, however perfect in theory, will require untiring energy, patience and perseverance to bear fruit. On this side of the Atlantic, in the United States, these antituberculosis schemes have been pursued with enthusiasm, with the result that Washington in 1920 had a death-rate from all forms of tuberculosis for 100,000 of the population of only 85, Chicago 97 and New York 126. London in the same year had a death-rate of 127, practically the same as New York. Other nations have not been so energetic in preventive measures, Vienna having in 1920 a death-rate of 405 and Paris 279 per 100,000 from the same cause.

It is evidently the duty of every nation to take up arms against a disease which exacts such a terrible toll of death, suffering and inefficiency. If this were done with energy and enthusiasm it is not too much to hope that in a few generations the tubercle bacillus would be practically brought under control and with it many other malign influences.

Infectious Diseases—(B) Protozoal

I shall now pass on to the consideration of the second great group of infectious diseases, the protozoal, and consider what methods of prevention have been found applicable to them.

The scientific study of the protozoal diseases of man may be said to have begun with the epoch-making discovery of the malaria parasites in 1880 by the illustrious Frenchman, Laveran; next, in 1893, the discovery by Theobald Smith and Kilborne of the cause of Texas fever and the part played in its dissemination by the cattle-tick; in 1894 the discovery of the trypanosome of nagana and its intermediate insect host, the tsetse fly; in 1898 the working out of the development of the malaria parasite of birds in the mosquito by Ronald Ross, greatly aided and abetted in the work by Patrick Manson, which led, through the work of Grassi and his fellow-workers in Italy, to the final solution of the malaria problem. A year later the important discovery of the mosquito carrier of yellow fever was made by the American Army Commission, under the directorship of Reed, and in 1903 Leishman announced his discovery of the protozoal cause of kala-azar.

These protozoal diseases are world-wide, like the bacterial, but it is in the warmer climates that their effect is most felt. The great plagues of the tropics, such as malaria, amœbic dysentery, kala-azar and sleeping sickness among men, Texas fever, tsetse-fly disease and others among domestic animals, are caused by minute microscopical animal parasites. Large tracts of country have been and are still rendered uninhabitable to white settlers by their presence. The opening up of Africa, for example, was rendered

difficult by the tsetse fly, before the advent of railways. No sooner had an expedition started for the interior than the fly attacked the cattle transport, and before long the expedition had to make its way back as best it could to its base on the coast. The only way to get into the country was on foot with native porters.

The protozoal diseases of domestic animals have also led to enormous loss in all parts of the world. Texas fever, or red-water, has swept whole countries of their cattle. After the Boer war, South Africa was devastated by the introduction of East Coast fever, another protozoal disease of cattle closely related to Texas fever.

How is the prevention of these diseases to be brought about? We find that up to the present little can be done by way of vaccination or inoculation or by the use of anti-sera as in the bacterial diseases. On studying the natural history of these protozoal parasites, however, it is found that many of them depend on an intermediate insect host for their continued existence, and it is by taking advantage of this characteristic that methods of prevention can be devised.

To illustrate this, I might cite the classical examples of malaria and yellow fever, but, as these must be familiar to you all, I shall take instead the trypanosome diseases of Africa, the best known of which are sleeping sickness in man and nagana or tsetse-fly disease in the domestic animals.

Nagana or Tsetse-fly Disease

In 1894, a year after Theobald Smith and Kilborne had published their famous monograph on Texas fever, a severe epidemic among native cattle in the north of Zululand was reported to the Natal government. The disease was called nagana by the natives, and it is curious that there was no suspicion at the time that it had any connection with the tsetse fly.

At this time a very enlightened administrator, the late Sir Walter Hely-Hutchinson, was governor of Natal and Zululand, and it was due to him that the investigation of the cause of the Zululand outbreak was at once undertaken. As I happened to be stationed in Natal at this time, I was chosen to undertake the work, and at once started on the long journey, mostly by ox-wagon, to the scene of the outbreak.

On examination of the blood of the nagana cattle, a minute active flagellated protozoal parasite, belonging to the genus Trypanosoma, was discovered, and after many experiments on dogs, horses and cattle it was decided that in all probability it was the cause of the disease. Trypanosomes had previously been described in the blood of rats and horses in India by Timothy Lewis and Griffith Evans, but nothing was known as to the mode of their transmission from animal to animal. It seemed as if the discovery of the nagana trypanosome would have ended the investigation in Zululand without any means of preventing the disease being discovered, but another observation made at this time threw more light on the subject.

In the low country between the high ground, on which the nagana camp was situated, and the sea there happened to be a so-called "fly belt." Every schoolboy had read about the tsetse fly in books of travelers and hunters, especially in those by the most famous of them all, David Livingstone, the missionary, and out of curiosity I decided to find out what happened when an animal was bitten by the fly, or, as it was termed, fly-struck. Natives were therefore sent with cattle and dogs into this "fly country," with orders to form a camp and expose the animals to the bites of the fly. This was done and it was with great surprise that on their return to the hill the blood of these fly-struck animals was found to contain the same parasite as that found in the nagana cattle.

Nagana and tsetse-fly disease were finally proved to be identical. The tsetse-fly disease was shown to be caused, not, as had been believed, by the poisonous bite of the fly, but by the transference of a protozoal parasite from the fly to the animal in the act of sucking blood. Now the question arose as to where the fly found the parasite. As the tsetse flies constantly lived among and fed on wild game, such as buffalo and antelope, these animals were suspected. Their blood was examined, and before long it became evident that the wild animals acted as the reservoir of the disease, the trypanosome living in their blood as harmless parasites. When the tsetse fly fed on blood containing the trypanosome it became infected and was capable by its bite of giving rise to a fatal disease in cattle, horses or dogs; whereas if it fed on a wild animal nothing happened, as the wild game are immune to the disease, much in the same way as the goat is immune to Malta fever.

Now that the natural history of the disease had been so far worked out it was evident that its prevention might be attempted. This can be done in any of three ways: by getting rid of the wild game, the reservoir; or by getting rid of the fly, the vector or carrier; or, lastly, by removing the cattle, horses and dogs to a safe distance from the "fly country."

This work on nagana led later, in 1903, to the discovery of the cause and mode of prevention of sleeping sickness.

Sleeping Sickness

About the beginning of the century an epidemic of this disease raged round the shores of Lake Victoria in Central Africa. It had been introduced into Uganda from the West Coast, where it had been known for many years as a curious and unaccountable

disease. It was observed that although the disease spread in a West African village from man to man apparently by contact, no such thing occurred among natives exiled from their homes. The disease never spread if introduced into native compounds in the West Indies or America, however closely the slaves might be herded together.

The disease remained shrouded in mystery and nothing had been done in the way of prevention, until the matter was taken up by the Royal Society of London in 1902 and a commission sent out to investigate.

It is not necessary to go into details; suffice it to say that after one or two false starts the commission in 1903 came to the conclusion that the disease was caused, as in nagana, by a species of trypanosome.

The question of the distribution of sleeping sickness in Uganda was then taken up. This disclosed the remarkable fact that the disease was restricted to the numerous islands in the northern part of the lake and to a narrow belt of country skirting the shores of the lake. In no part of Uganda were cases found more than a few miles from the lake shore.

The next important step in the working out of the etiology was made when it was shown that the distribution of the disease was identical with the distribution of the common tsetse fly of the country, *Glossina palpalis*. Where there was no fly there was no sleeping sickness.

The problem was now solved. The epidemic could be stopped either by getting rid of the fly or by removing the natives out of the fly area. As the destruction of the fly was impracticable under the circumstances, the second method was decided on. The natives were moved from the islands and lake shore and placed on healthy inland sites, and the epidemic, which had cost the Protectorate some 200,000 lives, speedily came to an end.

This method of preventing disease, by removing man out of the zone of danger, is an extravagant one and can only be done in exceptional circumstances. In Uganda the native population could be easily moved, but it meant that from about 1910 until the present day some of the most fertile land in Uganda has been lying derelict, has returned to the primitive jungle. The war delayed things, of course, but it is only now that the natives are being returned to their old homes on the islands and lake shore, in the hope that the fly by this time has lost its infectivity.

The other method, by the destruction of the tsetse fly, has been carried out successfully in other places. For example, in the island of Principe, off the West Coast of Africa, by destroying the wild animals which supplied a large part of the food of the fly and by clearing the jungle the tsetse flies disappeared, and with them the disease. This is the method employed in malaria and yellow fever. It was by destroying the mosquito carrier that Gorgas drove yellow fever out of Havana and later both malaria and yellow fever from the Panama Canal Zone.

Thus through the work of Manson, Laveran, Ross, Reed and others has it been made possible to deal with these two scourges of the tropics, malaria and yellow fever. I include yellow fever among the protozoal diseases, although Noguchi in 1919 brought forward strong evidence that it was caused by a spirochete.

In regard to the yellow fever the victory has been almost won. During the last century this disease, known as "yellow jack," devastated the West Indies and Central and South America. At the present time, thanks chiefly to the unremitting efforts of the late General Gorgas and the International Health Board of the Rockefeller Foundation, the disease has been driven out of the West Indies and Central America and only retains a precarious foothold in Mexico and Brazil.

So also in the case of malaria. A dozen years ago, based on the experience gained by Ross on the West Coast of Africa and Ismailia and by Watson in the Federated Malay States, the method of prevention by mosquito control and drainage has been so perfected that the practical blotting out of malaria from a given locality is now merely a matter of expense. A great deal of work has been done during the last few years in the way of experiment in the United States, and Vincent, the president of the Rockefeller Foundation, lately stated that there is evidence that "under normal conditions an average community can practically rid itself of malaria at a *per capita* cost of from 45 cents to $1 per year."

This is an altogether inadequate account of the methods of preventing these highly important protozoal diseases. From the few examples given it will be seen that they are most rampant in warm climates, that they are as a rule conveyed from the sick to the healthy by an insect intermediary, and that it is by an attack on this insect, be it mosquito, tsetse fly or tick, that the best chance of success in prevention lies.

INFECTIOUS DISEASES—(C) UNDETERMINED GROUP

In addition to the bacterial and protozoal infectious diseases, there is a third and large class, known as the "undetermined group," in which the parasite is either unknown or doubtful. Many of these undetermined diseases are very common and familiar, such as influenza, measles, scarlet fever, smallpox, typhus fever, trench fever, dengue fever and sand-fly fever; among animals, rabies, rinderpest, foot-and-mouth disease and African horse-sickness.

The theory generally held at present in regard to most diseases included in this group is that the living

germs causing them are ultra-microscopical in at least some part of their life history, and this is strengthened by the fact that many of them pass through porcelain filters, which keep back the smallest of the visible bacteria. Hence the name, "filter-passers."

Many of these undetermined diseases are highly infectious and appear to infect at a distance through the air, as, for example, in the case of influenza, scarlet fever and smallpox. In some of them there is no attempt made at prevention, except that the sick are isolated and placed under quarantine for a longer or shorter period. But in others there are well-known methods of prevention even when the virus is quite unknown. The best example is smallpox, the ravages of which have been completely held in check since the memorable discovery of Jenner. As has already been argued, this method of prevention, by inducing a mild or attenuated form of the disease, is at best a clumsy one, and when the natural history of the smallpox virus is better known it may be hoped that a more fundamental method of preventing this disease may be discovered. In the meantime the best means at our disposal is by the use of vaccine lymph, and people should recognize their responsibility to the community if through ignorance or selfishness they refuse to have their children vaccinated.

Another well-known disease, with an unknown virus, rabies or hydrophobia, has also, by the genius and intuition of Pasteur, been robbed of many of its terrors. The mortality following bites of rabid animals has fallen from 16 per cent. to less than 1 per cent. But in rabies, when the conditions are favorable, the radical method is to drive the disease altogether out of the country by the careful administration of muzzling and quarantine laws. This was carried out successfully in England at the beginning of the century.

Trench Fever

There are among the diseases of undetermined origin a few which are slowly emerging from the unknown into the known. One of the most interesting of these is trench fever, which came into great prominence during the war. The history of the investigation of this fever is interesting and well illustrates the method of studying a disease with a view to its prevention.

Before the war, trench fever was unknown, though there is some evidence that it had been recognized at an earlier date in Poland and called Wolhynia fever. Be that as it may, it is quite certain that, though it was unknown on the Western Front at the beginning of the war, it is no exaggeration to say that it became one of the most powerful factors in reducing our man-power, probably more than a million cases occurring among the Allies on the Western Front. In 1917 in the Second British Army alone, out of a total of 106,000 admissions to hospital at least 20,000 of the cases were trench fever.

Although this fever has well-marked characteristics of its own, such as a peculiar type of temperature curve and other symptoms, yet for a long time it was unrecognized as a separate entity and remained mixed up with other diseases, such as typhoid fever, malaria and rheumatism. In 1916, MacNee, Renshaw and Brunt in France made the first definite advance by showing that the blood of trench-fever cases was infective. They succeeded in transferring the disease to healthy men by the injection of the blood. The most careful microscopic examination of the blood corpuscles and lymph failed, however, to reveal any living germ. Nothing more was done until the following year, when the British War Office took the matter up seriously and formed a committee for the purpose of investigating the disease.

The United States of America, on coming into the war, at once recognized the importance of trench fever and without delay also undertook its investigation. In October, 1917, at the first meeting of the Medical Research Committee of the American Red Cross in Paris, Major R. P. Strong recommended that a research into trench fever should be undertaken. He stated that, after several months' study of the problems relating to the prevention of infectious diseases occurring in the Allied Armies on the Western Front, it became evident that the subject of the method of transmission of trench fever was one of the most important for investigation in connection with the loss of man-power in the fighting forces.

At the next meeting, in November, 1917, this was agreed to, and a Trench Fever Committee, under the chairmanship of Major Strong, was formed. The research was organized and experiments begun on February 4, 1918. In less than six months the investigation was completed and the report in the hands of the printer. This is a striking example of research work which, if carried out at the beginning of the war instead of at the end, might have saved the Allied armies hundreds of thousands of cases of disease, which, although never fatal, were often of long duration and led to much invaliding.

The most important result of the work of these two committees was that it was amply proved that the louse, and the louse alone, was responsible for the spreading of the disease. This discovery meant that in a short time trench fever would have disappeared from our armies on the Western Front. Just as the elimination of goat's milk blotted out Malta fever, the elimination of the mosquito, malaria and yellow fever, so would the elimination of the louse have completely blotted out trench fever.

This method of prevention, by the destruction of

the louse, although doubtless requiring careful organization and energy in carrying out, was shown before the end of the war to be a perfectly practicable proposition, and there can be little doubt that, if the war had lasted much longer, trench fever, like tetanus, would have practically disappeared.

Besides the main discovery from the preventive point of view that the louse is the carrier, there are many other points of interest in the natural history of trench fever. The living germ causing it has never been recognized in the human blood or tissues, probably on account of its extreme minuteness and its consequent liability to confusion with other small granules. But when the louse sucks blood from a trench-fever case there is apparently a great multiplication and development of the supposed microorganism. In five to nine days the louse becomes infective, and there is seen in the stomach and intestines enormous numbers of very minute bodies. What the exact nature of these bodies is, is unknown, but there can be little doubt that they are the infecting agents by which the louse passes on the disease. They pass out in countless numbers in the droppings or excreta of the louse, and it is to these bodies in the excreta that infection is due. The louse seldom if ever gives rise to the disease in the act of biting. It is the infective excreta thrown out on the skin which causes the infection. The micro-organisms or so-called Rickettsia bodies contained in the excreta find their way into the blood through abrasions or scratches and so give rise to the fever.

From what has been said it will be seen that trench fever is an interesting disease. It also explains why it disappears in times of peace. As soon as the war was ended and our men could leave the trenches and resume their normal habits, the disease disappeared. The louse was eliminated and the trench fever with it.

Typhus Fever

Another disease of the undetermined group closely related to trench fever and also carried by the louse is typhus fever, another of the furies following on the heels of war. The French and British armies escaped this scourge to a great extent, but some of the other countries, such as Serbia, Bulgaria and Poland, were not so fortunate. It is stated that 120,000 Serbians died of this disease during the war, and it was only after vigorous steps had been taken in sanitary measures directed against the louse that the epidemic was got in hand.

After the long, exhausting Napoleonic wars, with the resulting poverty and destitution, typhus fever was prevalent in Great Britain and Ireland. About the middle of the century the improved economic conditions gradually led to the disappearance of the disease in Britain, although cases still occur in some parts of Ireland.

It is to Nicolle that we owe this advancement in our knowledge of this important disease. His work in Tunis on this subject dates from 1909. He showed that the blood of typhus cases is infective to monkeys, and, most important of all, that the infection takes place through the body louse. Just as in trench fever, the louse becomes infective after some five days, and it has lately been shown by the late Arthur Bacot, of the Lister Institute, that the excreta is also infective.

The minute bodies found in the typhus louse are subject to some differences, very similar to those found in trench-fever louse and have been named *Rickettsia prowazeki* by Rocha Lima. What group these bodies belong to is still a matter of discussion. Some consider them to be protozoa, with an ultra-microscopical stage in man and a developmental stage in the louse, while others look on them as minute forms of bacteria. Although there is still some doubt as to the pathological significance of these Rickettsia bodies, the work of Sargent, Rocha Lima, Arkwright and Bacot, Wolbach, Todd and Palfrey has done much to establish a causal relationship between them and these two diseases, typhus and trench fever. From the point of view of prevention, the important fact is that the infection is carried by the louse, and in the next great war it will be almost as necessary to prepare means for the destruction of the lice as of the enemy.

Rocky Mountain Fever

A third disease belonging to this interesting little group—Rocky Mountain fever—occurs in certain localities in the United States. It provides another instance of a virus transmitted by an invertebrate host to man. As the result of the work of Ricketts and of Wolbach the woodtick, *Dermocentor venustus,* is now recognized as the vector. Rickettsia bodies closely resembling those found in association with typhus and trench-fever virus have been shown to be present in the stomach and tissues of the tick, and the same bodies have also been demonstrated in the tissues of infected guinea-pigs.

Another interesting disease of the undetermined group is sand-fly fever, the virus of which is conveyed from man to man by the sand-fly. A new era in its study has been opened up by the work of Whittingham and Rook, who have learned how to handle, breed and keep sand-flies in captivity and have shown that the virus is transmitted from generation to generation of flies without intervening passage through man or other higher animal. The knowledge of the life history of the flies will no doubt lead in due course to the suppression of the disease.

Another type of invertebrate vector is the Kedani mite, *Trombicula akamushi,* which transmits the virus of Japanese river-fever to man from wild animals. The dangerous character of this disease (Tsutsuga-

mushi) and the minute size of the mite together have presented great difficulties to the Japanese investigators. Protection from the mite by special clothing and bathing after exposure to risk of infection are at present the most hopeful methods of prophylaxis.

The prevention of diseases of this group by means of antitoxic sera has also been used with some measure of success. Degkwitz and others in Germany have been reputed as having been very successful in protecting children from measles and scarlet fever by injecting them with a small quantity of serum from convalescent patients. This method has also been found very useful under suitable conditions to protect cattle from foot-and-mouth disease.

But far more hopeful than protection by serum alone is the use of a vaccine to produce a lasting immunity, combined with antitoxin to prevent the vaccine from producing unpleasant results—the so-called toxin-antitoxin method. Most of the diseases for which this method of prophylaxis has proved valuable have been diseases of animals, such as pleuropneumonia of cattle, rinderpest and foot-and-mouth disease; but quite recently the method of Dick, of Chicago, in scarlet fever has been supported by a number of observations. The system of testing and producing immunity is planned on the same lines as the Schick method for diphtheria.

DIETETIC DEFICIENCIES—DEFICIENCY DISEASES

The preceding account is but a short and meager history of the marvelous advance which has been made in the prevention of infectious diseases in our times, an advance due in great part to the work of two men, Pasteur the Frenchman and Koch the German; those who have come after them have merely followed in their footsteps, been their disciples.

Time will not permit even to touch upon the advances made in the prevention of other important diseases, such as the surgical infections and those caused by intestinal parasites, prominent among which are the hookworms and bilharzia. This advance has not been limited to the infectious group; it has been shared by other groups, notably those due to dietetic deficiencies, the so-called deficiency diseases. These deficiency diseases are just as important or even more important than the infectious, since they are always with us and exact an enormous toll in lowered health, lowered vitality, malformation and inefficiency.

Until a few years ago it was taught in the schools that a complete diet consisted of certain proportions of proteins, carbohydrates, fats and salts. But our knowledge is constantly increasing, our ideas about things constantly changing, and what is looked on today as absolute immutable truth to-morrow is seen in the light of some newer knowledge to be but a crude beginning. So the teaching concerning what constitutes a complete and healthy diet has changed, inasmuch as certain substances have been discovered in foodstuffs in the absence of which an adequate number of calories supplied in the form of proteins, carbohydrates, fats and salts can alone neither promote growth nor support life indefinitely. These accessory food factors or vitamins, as they have been named, are present in such minute quantities in foods that they have never been isolated, and their chemical composition is therefore unknown. It is still a matter of opinion as to whether they really constitute parts of the structure of living tissues or whether they merely act as catalysts of stimulators in the processes of growth and metabolism. That they are definite chemical substances which can be added to or removed from a foodstuff, with good or evil results, has, however, been abundantly proved.

The untutored savage living on the natural fruits of the earth and the chase knows no deficiency diseases. It is only when man begins by artificial means to polish his rice, whiten his flour and tin his beef and vegetables that the trouble begins. Civilized man, living in comfort, drawing his food supply from the whole earth and able to vary his dietary at will, is in little danger; but it is otherwise with children and adults living under institutional conditions, with armies on active service, encountering extremes of climate, and with young infants on their naturally restricted diet. While it is true that deficiency diseases will only develop to their well-marked dangerous stage if the deficiency of accessory factors is severe and protracted, a slighter deficiency, if prolonged, may cause a condition of general ill health and inefficiency not less important although ill defined and difficult to diagnose. This fact is of special importance in the case of infants and young children.

The Discovery of Vitamins

At the present time three, and possibly four, distinct vitamins have been described and studied, and it is probably only a matter of time for others to be discovered.

The discovery of vitamins dates to the middle of the eighteenth century. In 1747, James Lind, a surgeon in the British Navy, carried out a series of experimental observations upon sailors suffering from scurvy, the conception and performance of which were entirely admirable. By appropriate control experiments he showed that the medical means in vogue for the treatment of the disease were futile, when not harmful, but that orange and lemon juices were a specific cure. Lind attempted to ascertain the relative antiscorbutic value of various fruits and green vegetables, but was unable to observe a "superior virtue" in one rather than in another. He confirmed Kramer's observations made at the beginning of the

eighteenth century, during the war between the Turks and the Holy Roman Empire, that dried vegetables were useless, and adopts the explanation of his friend Cockburn "that no moisture whatever could restore the natural juices of the plant lost by evaporation," which Cockburn imagined were "altered by a fermentation which they underwent in drying." Lind was struck with the beneficial effect of cow's milk in the treatment of scurvy. He explained it on the supposition of the milk "being a truly vegetable liquor, an emulsion prepared of the most succulent wholesome herbs." Lind applied himself to the applications of these discoveries for the prevention of scurvy in the navy, and recommended lemon juice concentrated to a syrup by evaporation to be carried in all ships and served out to the sailors.

By the beginning of the nineteenth century the carriage of lemon juice was made compulsory, first in the navy and subsequently in the mercantile marine, with the result that the ravages of scurvy were prevented. With the advent of steam traction, too, the length of voyages was curtailed and supplies of fresh provisions were obtained at more frequent intervals. Scurvy became rare, and the medical profession, being no longer faced with this disease of dietary deficiency, soon forgot the significance of Lind's discoveries.

Before leaving this subject a curious fact may be related. The lemon juice supplied to the navy was at first made from lemons grown in Spain and the Mediterranean countries. Afterwards, when England took over the West Indies, it was made from the lime, and scurvy again broke out. The reason of this is now known to be the fact that, whereas the lemon is particularly rich in antiscorbutic vitamin, the lime is correspondingly poor.

The scientific study of the disease may be said to have lapsed for a century and a half, until Holst and his coworkers in Copenhagen investigated the etiology of scurvy anew on modern lines, with the help of experiments on animals. Their work, published in 1907 and 1912, formed the basis for the numerous researches carried out in England and America during and since the recent war. As a result of this work the etiology of scurvy, discovered in effect centuries earlier, has been firmly established as due to lack of a specific, undetermined and as yet unisolated constituent of fresh foods, especially of fresh vegetables and fruits, now known as Vitamin C.

In the meantime the existence of a second vitamin, the so-called anti-beri-beri, or antineuritic vitamin, had been discovered. Eijkman's admirable studies at the end of last century, in 1897, on the etiology of beri-beri in the Dutch Indies brought forward evidence for the view that this disease was of dietetic origin and was caused by a diet consisting too exclusively of highly milled and polished rice. He showed that the disease could be prevented if the outer layer (or pericarp) and the embryo of the seed, which had been removed in the process of milling, were restored to the "polished" rice. Eijkman's discovery of the analogous disease in birds, *Polyneuritis gallinarum*, provided the necessary tool for further investigation of the subject. The researches of Grijns and others showed that the bran and polishings of rice were only one of many rich natural sources of the unknown principle preventing beri-beri, and it became evident that, while the disease is usually confined to tropical races subsisting largely on rice, the European white-bread eater is only protected by the varied diet he usually enjoys. Experience on active service shows that beri-beri may really develop on a diet of tinned meat and white bread or biscuit.

During the late war two examples of the use made of this new knowledge occurred in Mesopotamia.

At the beginning of the campaign, on account of a difficulty in transport, there was a shortage of fresh food, with the curious result that scurvy broke out among the Indian troops and beri-beri among the British. The Indians were living on dried pulses, such as peas, beans and lentils; the British on tinned beef and biscuits. The former diet was deficient in the antiscorbutic vitamin on account of the complete drying of the seeds; the latter in the anti-beri-beri factor on account of the use of white flour from which the germ had been removed.

Some years ago it had been discovered that if dried seeds are germinated, a quantity of the antiscorbutic vitamin is produced by the act of sprouting. This was done. The dried peas and beans were soaked in water and then spread out in shallow layers, to cause them to sprout, which they readily did in the warm climate. The germinated seeds were then issued to the Indian troops and cooked in the usual way. As a result of this simple procedure the scurvy completely disappeared, no new cases occurred and the sick recovered. In regard to the British troops it was known that the anti-beri-beri vitamin is contained in large quantities in certain cells, and notably in yeast cells. A small quantity of this substance in the form of marmite was added to the soldier's diet of bully-beef and biscuits, and the beri-beri in like manner disappeared.

It may seem strange that the conception of the rôle of vitamins in nutrition should have come first from the pathologist, and should not have emerged from the important advances in our knowledge of the physiology of nutrition which were made during the second half of the last century. The physiologists were preoccupied with the chemical composition of foodstuffs and their value for supplying energy and supporting growth, and with the necessity for supplying the requisite number of calories in a diet, distributed appropriately among proteins, fats and car-

bohydrates, with adequate selection of mineral salts. It was only when these researches led to experiments in which animals were fed upon various mixtures of purified food elements that the investigators in this field began to realize that their repeated failures to rear animals upon such carefully arranged diets were not due to accident. The truth was suspected by Lunin in 1881, but it was not until 1912 that Hopkins published the classic experiments which proved the fact beyond a doubt. In the course of work along the same lines in the United States, McCollum and Davis in 1915 rediscovered Vitamin B, and, in addition, a third essential dietary constituent, a fat-soluble vitamin, present in butter-fat and certain other fats of animal origin, especially in cod-liver oil and other fish oils. This vitamin is known as fat-soluble Vitamin A.

Rickets as a Deficiency Disease

The discovery of the fat-soluble vitamins proved to be of great importance in elucidating the etiology of this disease, which had for long been an unsolved problem. Some authorities had erroneously considered it to be an infectious disease, like tuberculosis. Another school held the so-called domestication theory, that it was caused by unnatural surroundings, involving a want of sunlight, fresh air and exercise. A third considered rickets to be caused by improper feeding, though opinions differed as to the exact nature of the dietetic defect. The conclusion, first put forward by Mellanby in 1918, that a deficiency of fat-soluble vitamins plays a most important part in the causation of the disease is now generally accepted. This has been established by a large amount of work, both experimental and clinical, carried out by Mellanby himself, McCollum and Hess and their respective coworkers in the United States, and Korenchevsky and others in England. It may be laid down that if a young animal is supplied with a sufficiency of these vitamins, rickets will not develop. The question of prevention is therefore one of economics. The difficulty is that these fat-soluble vitamins are chiefly found in such foodstuffs as butter, eggs, the fat of beef and mutton and fish oils, all expensive articles of diet which the poorer classes can seldom afford. The only "butter" used by them is probably some form of margarine, made from vegetable oils which contain little or no antirachitic vitamin. The question of prevention is for the sociologist. Science can only discover the causes and point the means. It is for governments and local authorities to carry out preventive measures in practice, and it is to be feared that science is often far ahead of the community in its share of the work.

Although the theory that rickets is an infectious disease has been exploded, a great and remarkable truth was contained in the domestication and hygienic theories which held that, among other unhygienic conditions, want of sunlight was concerned in the etiology of the disease. During the last five years it has been discovered that exposure to sunlight or to the ultraviolet rays of the mercury vapor quartz lamp can cure rickets in children. Experiments on animals have shown that the effective rays in the sunlight are also the ultra-violet. This discovery has indicated lack of sunlight during winter as one factor concerned in the large spring incidence of the disease in industrial cities in northern climates.

A complete and well-controlled research showing the interaction of diet and light in the prevention and cure of rickets in infants was gained in Vienna, since the war, by Dr. Harriette Chick, of the Lister Institute, and her four colleagues. There the curious fact came to light that infants fed on a diet deficient in antirachitic vitamin only developed the disease in winter and not in summer, and, moreover, could be cured in winter by exposure to artificial forms of radiation or by administration of cod-liver oil without any other change in diet or management. Another set of children who had a sufficient supply of fat-soluble vitamins in their diet, in the form of cod-liver oil, escaped the disease altogether.

Experiments on rats have also shown that in animals fed on a rickets-producing diet, rickets does not occur if the rats are exposed regularly to sunlight or to the rays of the mercury lamp, or other form of artificial ultra-violet radiation; whereas, if they were kept in the dark, rickets does develop. If, on the other hand, the diet was complete in all respects, including abundance of fat-soluble vitamins, the animals do not develop the disease, even if kept constantly in the dark. How this is brought about is not known. At one time it was thought that the action of the ultra-violet rays on the tissue might enable the animal to synthesize fat-soluble vitamins, as it does in the tissues of plants, but recent evidence brought forward by Miss Margaret Hume, in Vienna, and by Goldblatt and Soames at the Lister Institute, suggests that light can neither create nor act as a substitute for the vitamin. It seems rather to act as a stimulant, enabling the animal to make full and economical use of its store of fat-soluble vitamins, and when the store is used up growth ceases in spite of the continued action of the rays.

An important and practical point in regard to the connection between diet and sunlight and the formation of the antirachitic vitamin is the relation to cow's milk. Recent work carried out by Dr. Ethel Luce at the Lister Institute has shown that milk obtained from a cow on pasture in summer contains a sufficiency of the growth-promoting and antirachitic fat-soluble vitamins. In winter, on the other hand, if the cow

is stall-fed and kept in a dark stable, the milk may become deficient in these respects and young animals fed on it may become rachitic. This work shows that the seasonal variation in quality of the cow's milk may be an additional factor in the seasonal incidence of infants reared upon it. It also disposes of the idea, very current in some quarters, that cow's milk possesses low and negligible antirachitic properties and that the antirachitic properties of cod-liver oil are specific and peculiar to that substance. Enough has been said to show that rickets may be regarded as a disease of sunless houses, combined with a diet deficient in the antirachitic vitamin, and the means of prevention are sufficiently obvious, if not always easy and simple to carry out.

Doubtless in the future this new knowledge in regard to the accessory food factors in diet will be used to a greater extent than it has been up to the present, in which case it is not too much to expect that the city children of some future generation will have better-grown bodies and stronger, healthier teeth than their predecessors of the pre-vitamin age. This might be attained in a comparatively near future if only man could be allowed to work out his salvation in peace. Instead of this, great wars come and throw back the work for generations.

To saddle the country with a million and a half of unemployed, with the consequent poverty, insufficient food, clothing and housing, is not calculated to further the prevention of disease and raise the standard of health. Is it too much to hope that sometime in the revolving years a time may come when by a Confederation or League of Nations the world may be so policed that no one country will be able with impunity to attempt the destruction of its neighbor? Until this happens it is difficult to see how rickets, tuberculosis and other diseases can be adequately dealt with in our city populations.

Diseases due to Ductless Glands

I can only briefly allude to the astonishing advance in our knowledge of the diseases caused by a defect or excess of secretion of the ductless glands. Many of these discoveries are among the fairy tales of science. All this advance has taken place in the comparatively short space of time under review. Professor Starling, one of the chief protagonists in this advance, in his Harveian Oration a year ago states this very vividly:

> When I compare our present knowledge of the workings of the body and our powers of interfering with and of controlling those workings for the benefit of humanity with the ignorance and despairing impotence of my student days, I feel that I have had the good fortune to see the sun rise on a darkened world, and that the life of my contemporaries has coincided not with a renaissance but with a new birth of man's powers over his environment and his destinies, unparalleled in the whole history of mankind. Not but there is still much to be learned: the ocean of the unknown still stretches far and wide in front of us, but for its exploration we have the light of day to guide us; we know the directions in which we would sail, and every day, by the cooperation of all branches of science, our means of conveyance are becoming more swift and sure. Only labor is required to extend almost without limit our understanding of the human body and our control of its fate.

There is one point of likeness between the vitamins which we have been considering and these glandular secretions or hormones, as they are named. Just as we have seen that the presence or absence of an extremely minute quantity of a vitamin may determine growth and health or disease and death, so an extremely minute quantity of glandular secretion may have a similar effect.

The anterior lobe of the pituitary gland is a very small body, yet an excess of its secretion will cause a child to grow into a giant; a deficiency, and the growing child will remain an infant.

The best known of the ductless glands is the thyroid, and the effect of its secretion is truly marvelous. A deficiency, and the child grows up a heavy-featured, gibbering idiot. Rectify the supply of thyroid secretion: the heavy features disappear, the eyes brighten, the intelligence returns, and instead of the former heavy-jowled imbecile you have a bright, happy and normal schoolboy. On the other hand, if there is an excess of the thyroid hormone, exophthalmic goiter, or Graves's disease, is the result. Remove the redundancy and health returns.

The active principle of the thyroid has lately been shown to be a compound containing iodine. If there is no iodine in the soil or water, goiter is the result, as in parts of Switzerland, Canada and the United States. This aspect of the subject was taken up some ten years ago by Dr. David Marine and his colleagues at Cleveland, Ohio. They found that endemic goiter may be prevented by the simple method of giving for a time minute doses of iodine, and conclude that with this simple, rational and cheap means of prevention, this human scourge, which has taken its toll in misery, suffering and death throughout all ages, can and should be controlled, if not eliminated, and look forward in imagination, a few generations hence, to the final closing of the chapter on endemic goiter and cretinism in every civilized nation in the world.

Many advances have also been made in our knowledge of the function and uses of other ductless glands, and, as you know, the latest victory in this field is the discovery of insulin and the successful treatment of severe diabetes, for which magnificent work your own townsmen Banting and Best deserve the highest honor.

In many other directions than those touched upon has there been progress in the prevention of disease. It would take more than one address to describe the activities of the Rockefeller Foundation alone. Campaigns for the relief and control of hookworm disease, malaria control, the eradication of yellow fever, antituberculosis work and education are being pursued on such a scale and at such a lavish expenditure of money as to leave us in the Old Country breathless with admiration and envy. This foundation, incorporated in 1913, was founded, in the words of the president, "to stimulate world-wide research, to aid the diffusion of knowledge, to encourage cooperation in medical education and public health." Its chartered purpose is to promote, not the exclusive prosperity of any one nation, but "the well-being of mankind throughout the world."

Science, indeed, knows no boundaries of nations, languages or creeds. It is truly international. We are all children of one Father. The advance of knowledge in the causation and prevention of disease is not for the benefit of any one country, but for all—for the lonely African native, deserted by his tribe, dying in the jungle of sleeping sickness, or the Indian or Chinese coolie dying miserably of beri-beri, just as much as for the citizens of our own towns.

From what has been said it is abundantly clear that during the comparatively few years that have passed since this association first met in Canada, enormous advances have been made in the prevention of disease. Before that time we were still in the gloom and shadow of the dark ages. Now we have come out into the light. Man has come into his heritage and seems now to possess some particle of the universal creative force in virtue of which he can wrest from nature the secrets so jealously guarded by her and bend them to his own desire. But let there be no mistake; much has been done, but much more remains to be done. Mankind is still groaning and travailing under a grievous burden and weight of pain, sickness and disease. Interruptions are sure to come in the future as they have in the past in the work of removing the incubus, but, in spite of these, it is the duty of science to go steadily forward, illuminating the dark places in hope of happier times.

DAVID BRUCE

ORGANIZED COOPERATION AMONG MUSEUMS

IN the spring of 1923 the museums of the United States embarked upon a program of joint effort. The American Association of Museums was made over, so to speak, into an organization dependent no longer upon volunteer work, as it had been for nearly two decades. National headquarters were established at Washington, D. C. The nucleus of a permanent staff was engaged, a program was laid out for the ensuing year and a prospectus was drafted for many years to come. All this was made possible by an assured support from various sources of $25,000 for the first year and of $30,000 for each of two years more.

Appropriately enough, these events transpired at the Charleston meeting of the association, which marked the completion of a century and a half of museum history in America.

The first year of this experiment has just come to a close, with the nineteenth annual meeting of the association, which was held in Washington, D. C., on May 10 to 13. The meeting ended with a dinner at which the speakers were His Excellency, the ambassador of the French Republic, the United States commissioner of education, the president of the Carnegie Institution of Washington and the permanent secretary of the National Research Council. This event was an appropriate finish to an occasion which has gone far towards establishing the association on a high plane and which has given new energy to the movement which the organization represents.

The report of the secretary showed what program twelve months have witnessed. A few excerpts follow:

The work of the year has divided itself between the Old World and the New. In Europe, Director Charles R. Richards has pursued a two-sided study, having made a survey of museums of industrial art and of applied art conditions in general on the one hand, and of museums of industry on the other. These projects have been financed by the General Education Board, which has given its cooperation to the association.

Just prior to Professor Richards's return in April, the General Education Board arranged to transfer to the association approximately $7,000—this being the unexpended balance of its original appropriation towards Professor Richards's survey. It also indicated that it stood ready to provide such further funds as might be needed for the completion of the work.

* * *

In this country the work of the association has gone forward from national headquarters at the Smithsonian Institution.

An important accomplishment has been the financial progress which has been made. Not only have the requirements laid down by the Laura Spelman Rockefeller Memorial been fulfilled by raising $15,000 to meet their grant of $10,000 for the year, but additional income has made it possible to increase the budget. The report of the treasurer shows a total income of $27,800.35, expenditures have been $20,804.67, and the year has closed with a previous deficit wiped out and with a balance of $6,050.86 of which $4,000 is a reserved fund.

* * *

Certain new support has developed during the year, which is now to become available for the second year of

operations. Under date of March 6, for example, the following communication was received from Dr. Beardsley Ruml, director of the Laura Spelman Rockefeller Memorial.

At the meeting of the Executive Committee of the Memorial, held this morning, the following resolution was passed:

Resolved, That the sum of $5,000 a year for two years, beginning July 1, 1924, be and it hereby is appropriated to the American Association of Museums upon condition that $10,000 a year be obtained from other sources; this $10,000 to be in addition to the $20,000 required to meet the Memorial's pledge of June 27, 1923.

Later the date was changed to May 1, so that the funds might be drawn upon from the outset of our new fiscal year. This grant was made prior to the grant of the General Education Board, reported above, and, therefore, the funds made available by the latter grant enable us to meet in large part the conditions of the memorial, and in consequence there should be no difficulty in completing the requirements at an early date, in order to make available an additional fifteen thousand dollars of income.

* * *

Before leaving the subject of finances, it is in order to report a piece of work which has led up to still another grant. In November, 1923, announcement was made through the Associated Press that the association stood ready to advise and consult with the officers of small and struggling museums and with groups contemplating the establishment of museums. The release was rewritten by editors throughout the country until it had occupied several hundred columns of space in newspapers and magazines. Clipping agencies are still returning stories which have developed out of it.

Within a few weeks of this release, a hundred or more letters were received asking for information and help, and in consequence the facilities of the office were taxed. The character of these inquiries demonstrated a need on the part of small museums for more help than could be given by letter. It seemed to justify establishment of field service.

These facts were laid before the Carnegie Corporation of New York, and as a result a grant of five thousand dollars was made for the year just begun.

With this grant it will be possible to make a constructive beginning. The first move will be to survey the field to make a careful analysis of conditions and to formulate well-considered recommendations on the subjects of museum organization, management, administration, functioning and technique. This survey will begin at an early date and will probably be completed before 1925, at which time the association should be in a position to publish a report of the investigation.

* * *

The total membership of the association has been increased by 50 per cent. during the year just closed.

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A number of special projects have engaged attention. Early in 1924 an invitation was received from the commercial attaché of France to interest ourselves in the International Exposition of Modern Decorative and Industrial Arts, which is to be held in Paris in 1925. At about the same time, a message was received from Professor Richards—then abroad—in which he dwelled upon the importance of this exposition, indicating that it might have an important bearing upon museum activities in the field of applied art in America. Professor Richards urged that efforts be made to assure American participation. Upon inquiry it was disclosed that a negative decision had been made by government officials and that the French government was about to be advised that our country would not be represented at Paris.

It was felt that the decision might have been different if the matter could have been brought to the attention of certain important industrial art manufacturers by Professor Richards, who is so intimately in touch with the situation. This belief was urged upon officials of the Department of State and of the Department of Commerce, and as a result, the United States government held a decision in abeyance for nearly three months in order that Director Richards might be given an opportunity to go over the possibilities.

Upon his return, Professor Richards addressed his first efforts to this problem, and while in fact it was not possible to enlist sufficient interest to reverse the decision made previously by the government, still there was satisfaction in having exhausted every possibility. This incident is an example of national service which the association is in a position to render.

* * *

At the suggestion of the association, the Honorable Herbert Hoover, secretary of commerce, had indicated his willingness to appoint a committee of the Department of Commerce—a committee on industrial art—and he has asked the association to suggest the personnel. The work of this committee is conceived to be the putting into operation of the results of Professor Richards's various studies—which accomplishment, incidentally, would be the means of drawing American museums more centrally into the current of the applied art movement.

* * *

Recently, after a series of conferences with the National Parks Service, the association developed a plan which it is hoped will make available $250,000 for the building of museums in national parks.

* * *

At headquarters publications have been one of the chief concerns. *Museum Work* has been improved in format, and is now operating under such headway that it can be made a monthly as soon as finances permit. A series of mimeographed news letters have developed into a semimonthly newspaper, *The Museum News.* Editorial copies of the latter publication are being sent by request to city editors in almost every state, and clippings which are returned indicate that it is being drawn upon regularly for news.

* * *

A number of magazines, most notably *School Life, American City,* SCIENCE and the Bulletin of the Pan-American Union, have run articles prepared by the staff. Trade journals have run items about the association's work, and the possibility of cooperation between museums and industries. Newspaper publicity has been clipped by agencies to a total of five hundred columns, and in considering these returns it must be remembered that agencies do not find more than thirty per cent. of what appears.

* * *

Employment information has been gathered and published regularly and a considerable number of positions filled. It is difficult to estimate the results of this service because successful candidates for positions rarely inform headquarters of their changes of employment.

Information service has been rendered regularly, but under some difficulties because of the wide range of information sought and the relatively slender facilities which headquarters has had during the past year for gathering and collating facts. The services of an information clerk, or special librarian, are needed for the new year.

* * *

A report for the year could hardly close without referring to a piece of progress which will not yield results until some time in the future, *viz.*, a plan to prepare public health exhibits, both for circulation and for permanent lodgment in museums. This plan is both described and endorsed in the following action taken by the International Association of Medical Museums at its annual meeting held in Buffalo, New York, on April 17, 1924.

WHEREAS, The American Association of Museums in conjunction with the National Committee on Exhibits of the National Health Council have in mind the development of detailed plans along the lines of health exhibits for the benefit of the United States; and

WHEREAS, These plans comprehend the development in detail of a Public Health Exhibit to be arranged and installed in the Smithsonian Institution in Washington, such exhibit to be completed and popular; and to prepare uniform labels for such an exhibit in lots; and to prepare one complete duplicate of such exhibit, this duplicate to be divided so as to be circulated among cooperating museums for temporary installation; and to estimate the cost of producing other duplicates of complete exhibit to be on sale by such committee; therefore, be it

Resolved, That we, the members of the International Association of Medical Museums, as an organization, learn with great interest the plans of the American Association of Museums, and realizing this plan to be of such importance as to commend itself to anyone interested in public health, and realizing further the great benefit of such exhibits particularly to school teachers and pupils, hereby endorse the idea and commend these plans.

Professor C.-E. A. Winslow, of Yale Medical School, has consented to serve as chairman of a committee to have general supervision of the project when it develops, and plans are now being formulated to finance it.

* * *

The first year of organized cooperation among museums has demonstrated the soundness of the idea upon which the new program of the association is based. It has shown that definitely useful work can be supported. It has opened up an alluring outlook for the association, but more than that, it has seemed to justify the belief that a new era for American Museums has dawned.

LAURENCE VAIL COLEMAN,
Secretary

THE FRANKLIN INSTITUTE

THE Centenary celebration of the founding of the Franklin Institute and the inauguration exercises of the Bartol Research Foundation will be held in Philadelphia, on September 17, 18 and 19, 1924. The principal events of the program are as follows:

Wednesday, September 17

9:30 A. M. Assembly of delegates and guests at the hall of The Franklin Institute, 15 South Seventh Street.

10:00 A. M. Academic procession from the hall of The Franklin Institute to the Walnut Street Theater. (Academic costume is in order.)

10:30 A. M. Invocation: Reverend Louis C. Washburn, Rector of Christ Church, Philadelphia.

10:30 A. M. *Address of Welcome:* The Honorable W. Freeland Kendrick, Mayor of Philadelphia.

Address: President Wm. C. L. Eglin.

Address: Professor Elihu Thomson, Honorary Chairman of the Centenary Celebration Committee of The Franklin Institute.

1:00 P. M. Luncheon to delegates and guests at the Bellevue-Stratford.

2:30 P. M. Sectional Meeting: The Academy of Natural Sciences of Philadelphia, the hall of The Franklin Institute, the hall of The American Philosophical Society, the hall of The Historical Society of Pennsylvania.

7:30 P. M. Informal Dinners.

Thursday, September 18

10:00 A. M. Sectional Meetings: The Academy of Natural Sciences of Philadelphia, the hall of The Franklin Institute, the hall of The American Philosophical Society, the hall of The Historical Society of Pennsylvania.

1:30 P. M. Luncheon to delegates and guests at the Bellevue-Stratford.

2:30 P. M. to 6:00 P. M. Garden party.

8:30 P. M. Open Meeting at the Academy of Music. President Wm. C. L. Eglin, presiding, will introduce the chairman of the evening, The Hon. William Cameron Sproul.

Address: "The natural and artificial disintegration of elements," by Professor Sir Ernest Rutherford, Trinity College, Cambridge.

Friday, September 19

10:00 A. M. Unveiling of tablet at Bartol Research Foundation.

10:15 A. M. The Academy of Natural Sciences.

Address: "The fifth estate," by Arthur D. Little, Cambridge.

Address: "Stimulation of research and invention," by Professor D. S. Jacobus, New York City.

11:30 A. M. Sectional Meetings: The Academy of Natural Sciences of Philadelphia, the hall of The Franklin Institute, the hall of The American Philosophical Society, the hall of The Historical Society of Pennsylvania.

2:00 P. M. Luncheon to delegates and guests at the Bellevue-Stratford.

7:30 P. M. Banquet to delegates and guests at the Bellevue-Stratford.

The following papers will be read before the sectional meetings:

Professor Joseph S. Ames, the Johns Hopkins University, "Recent development in aeronautics."

Professor Wilder D. Bancroft, Cornell University, "The development of colloid chemistry."

Professor Sir William Henry Bragg, Royal Institution, London, "X-rays and the structure of matter."

Professor William Lawrence Bragg, Victoria University, Manchester.

Professor P. W. Bridgman, Harvard University, "Some aspects of high pressure research."

General John J. Carty, American Telephone and Telegraph Company, New York City.

Professor E. G. Coker, University College, London, "Photo-elasticity."

William D. Coolidge, General Electric Company, Schenectady, "Modern X-ray tube development."

Director Arthur L. Day, Geophysical Laboratory, Carnegie Institution, Washington, "Some causes of volcanic activity."

Professor F. G. Donnan, University College, London, "The influence of J. Willard Gibbs on the science of physical chemistry."

William LeRoy Emmet, General Electric Company, Schenectady, "Mercury boiler."

Professor Charles Fabry, University of Paris, "Spectroscopy in past and present."

Professor F. Haber, Institut für Physikal. Chemie und Elektrochemie, Berlin, "Technical results of the theoretical development in chemistry."

Professor W. J. Humphreys, Weather Bureau, Washington, "The way of the wind."

Professor D. S. Jacobus, New York City, "Stimulation of research and invention."

George L. Kelley, Philadelphia, "The restraint of exaggerated grain growth in critically strained metals."

Professor A. E. Kennelly, Massachusetts Institute of Technology, "The measurement of acoustic impedance by the aid of the telephone receiver."

Dean Dexter S. Kimball, The College of Engineering, Cornell University.

Irving Langmuir, General Electric Company, Schenectady, "Electric discharges in gases at low pressures."

Arthur D. Little, Cambridge, "The fifth estate."

Professor C. H. Mathewson, Yale University, "The trend in physical metallurgy."

Director C. E. K. Mees, Eastman Kodak Company, Rochester.

Professor Charles E. Mendenhall, The University of Wisconsin, "Electronic phenomena at the surface of metals."

Professor A. A. Michelson, The University of Chicago.

Professor Dayton C. Miller, Case School of Applied Science, Cleveland, "The phonodeik."

Professor W. Lash Miller, University of Toronto, "Concentration and polarization at the cathode during electrolysis of solutions of copper salts."

Ralph Modjeski, Consulting Engineer, Philadelphia, "Unusual problems encountered in the design and construction of large bridges."

Daniel E. Moran, Consulting Engineer, New York City, "Some of the effects of loading granular material."

Sir Charles Algernon Parsons, Newcastle-on-Tyne, England, "Steam turbines on land and sea."

Major General Mason M. Patrick, U. S. Air Service, Washington, "Military aircraft and their use in warfare."

Dean Harold Pender, University of Pennsylvania, "A new type of non-inductive high resistance."

F. W. Peek, General Electric Company, Pittsfield, Massachusetts, "Lightning."

Director Charles L. Reese, E. I. du Pont de Nemours and Company, Wilmington, "Twenty-five years' progress in explosives."

E. W. Rice, Jr., General Electric Company, Schenectady, "The field of research in industrial institutions."

Professor Sir Ernest Rutherford, Trinity College, Cambridge University, "The natural and artificial disintegration of elements."

Professor Albert Sauveur, Harvard University.

Provost Emeritus Edgar F. Smith, University of Pennsylvania, Philadelphia, "Early science in Philadelphia."

Frank J. Sprague, New York City.

Major General George Owen Squier, War Department, Washington, "Electrical communications for military purposes."

Professor Julius Stieglitz, University of Chicago, "The theory of color production in organic and inorganic compounds."

Professor Bradley Stoughton, Lehigh University, Bethlehem, "Magnetic analysis of steel."

Professor W. F. G. Swann, University of Chicago, "The origin of the earth's electric and magnetic phenomena."

General Harry Taylor, U. S. Army, Washington, "Modern military engineering."

Professor Elihu Thomson, General Electric Company, West Lynn.

Professor John Sealy Edw. Townsend, University of Oxford, "Motion of electrons in gases."

Professor Augustus Trowbridge, Princeton University, Princeton.

Major General C. C. Williams, War Department, Washington, "Modern ordnance."

Professor Pieter Zeeman, University of Amsterdam, "Radiating atoms in magnetic fields."

SCIENTIFIC EVENTS

AMERICAN PROPOSALS TO THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION

THE following two items have been submitted to the International Geodetic and Geophysical Union by the American Geophysical Union and will appear on the agenda of the union at the meeting to be held in Madrid, Spain, from October 1 to 10:

Item I.—Discussion of the desirability of expediting the topographic mapping of all land areas of the world, as well as the mapping of the configuration of all oceanic basins.

Explanation.—A knowledge of the geographic location of all topographic features and of the configuration of the ground, both on land and in the depths of the sea, is essential in carrying on the various branches of the geophysical sciences. This is especially true in geodesy, volcanology, seismology, meteorology, terrestrial magnetism and scientific hydrology. It is scarcely necessary to go into details in this explanation of the proposed item for the agenda, as to the scientific values of topographic maps. Every one engaged on geophysical investigations has had experience which makes him familiar with the ease with which work can be carried on where good topographic maps are available, and the great difficulties which are encountered when he has to try to work in regions which have not been topographically mapped.

Aside from the scientific value of topographic maps there is a tremendous practical value. The great problem of the human race is to discover, develop, utilize and conserve the products of the land and the sea, which furnish the means by which people are kept alive. The world's population is increasing from year to year and consequently in the future greater amounts of supplies must be extracted from the earth and the sea. It would appear to be the logical method to pursue to make topographic maps, even though in some parts of the world they might be rather crude, in order to furnish a knowledge of geographic positions and the configuration of the ground. These surveys should be followed by investigations to determine the resources of each portion of the earth, both land and sea. These resources, for the land areas, would consist in soil fertility, forests, waterpower, irrigable lands, lands that may be drained and minerals of various kinds including oil and coal. With all this knowledge plans based on sound economic principles can be outlined which would make it possible to use the resources of the world in a rational way without depleting them to such an extent that future generations would suffer. Similarly, the resources of the different oceans could be determined and utilized in a rational way, and the information gained from a knowledge of the configuration of the oceanic basins would shed a flood of light upon geophysical sciences in general.

After discussing this item, the Union may decide to pass resolutions commending those countries which have already completed or nearly completed their topographic maps and urge that the unmapped areas of the earth should receive careful attention of the nations to which they belong. The oceanographic work already accomplished or being undertaken by the different governments should be noted and commended, and all nations should be encouraged to increase and extend their work in oceanography.

Item II.—Discussion of the advisability and methods of promoting international cooperation for the advancement of oceanographic and the cognate sciences of geophysics upon the basis of the International Council for the Exploration of the Sea.

Explanation.—It is worthy of note by geophysicists that, in the foundation upon which the future superstructure of geophysics is to be raised, there must be a knowledge of the configuration of the oceanic basins, and of the functions of the ocean and the properties of its waters.

The International Council for the Exploration of the Sea purposes, upon acquiring the oceanographic exploring vessel of the late Prince of Monaco, to extend its operations into the intercontinental oceans, thus passing out beyond the confines of the continental seas in which its labors have already resulted in important advances in the geophysical sciences.

The question proposed to be discussed is whether the International Union of Geodesy and Geophysics, in its aspects as an alliance among those earth-sciences whose interests are promoted by oceanic exploration, such as geology, seismology, volcanology, geodesy, meteorology and terrestrial magnetism, should seek, by resolution addressed to the International Research Council, to invoke international cooperation in supporting the prospective undertaking of the International Council for the Exploration of the Sea.

REORGANIZATION OF THE BUREAU OF MINES

UNDER an order approved by the Secretary of the Interior, the following-named technical divisions and offices of the Bureau of Mines have been recognized:

The Division of Mining Experiment Stations, with administrative control of the stations at Pittsburgh, Pa.; New Brunswick, N. J.; Columbus, Ohio; Minneapolis, Minn.; Salt Lake City, Utah; Tucson, Arizona; Seattle, Wash.; St. Louis-Rolla, Mo.; Birmingham-Tuscaloosa, Ala.; Reno, Nev.; Berkeley, Calif.

The Division of Metallurgy, charged with the conduct of researches in physics, chemistry and engineering connected with the metallurgy, ore dressing, reduction and refining of the ferrous and major nonferrous metals; specifically of iron, steel, copper, lead, zinc, aluminum, gold, silver and their alloys. This division will be under the direction of the chief metallurgist who will have administrative charge of the field studies now being conducted at Miami, Okla.; Moscow, Idaho; at the Massachusetts Institute of Technology, and at the Bureau of Standards; together with the cooperative studies on oxygen enrichment of air blasts.

Division of Mineral Technology, under the charge of the chief chemist.

Division of Fuels, under the charge of the chief mechanical engineer.

Division of Petroleum and Natural Gas, under the chief petroleum engineer.

Division of Mineral Leasing, to have charge of all work of the bureau relating to leases other than oil and gas, on the public and Indian lands. This division will be under the direction of an engineer-in-charge, headquartered at Washington, who may serve coincidently as chief mining supervisor.

Division of Mining Research, charged with the duty of conducting field and laboratory research as to mining methods in relation to safety, economy and efficiency in mining. This division will be under the supervision of an engineer-in-charge who will have technical supervision over all employees engaged in studies within its field and administrative control of the Urbana, Ill., staff, the Alaska staff, and such district and resident engineers as may be assigned to the work. The Division of War Mineral Supplies is abolished and its duties, records and personnel are transferred to this division. The present chief of the Division of War Mineral Supplies is detached from duty and will report to the director for special service.

The Safety Service, charged with the duty of disseminating throughout the mining and mineral industries the safety practices developed in or approved by the Bureau of Mines, will include the study, development and introduction of special mine rescue apparatus, the mine rescue work of the bureau, the mine rescue and first-aid training, the making of safety service reports, the holding of safety meets and rallies, and of mine rescue and first-aid meets and contests, and all extension work of the bureau devoted to increasing safety in the mineral industries. It will be in charge of the safety service director.

Chief Surgeon's Office, to be conducted by the chief surgeon, who will have technical supervision of all medical studies and studies of health hazards conducted by the bureau, and administrative control of all medical officers assigned to it. He will represent the bureau in cooperation with the Public Health Service.

Chief Explosives Chemist's Office, to be conducted by the chief explosives chemist, who will act as consultant in all studies of explosives conducted by the bureau, will approve all specifications for and tests made of permissible explosives, and will have technical supervision of the cooperation with the army, navy and other departments or institutions where the work relates to explosives.

Two Administrative Divisions, consisting of the Office of Chief Clerk, and the Information Service, as now organized, shall be recognized.

The present mine safety committee at the Pittsburgh station is abolished and in lieu thereof there is constituted a general mine safety board under the chairmanship of the chief mining engineer. It will include in addition the representatives of the Mine Safety and Mining Research divisions and of the chief surgeon and the chief mechanical engineer.

George S. Rice, chief mining engineer, is relieved of most of his administrative duties and will serve as advisor to the director and assistant director on mining matters with such special duties as may be from time to time assigned to him. For the present he will be in entire charge of matters relating to cooperation with the British government in studies of safety in mines. He will serve as chairman of the Mine Safety Board, and will have technical supervision over the studies conducted at the experimental mine at Bruceton, Pa.

NEW ENDOWMENT FOR THE JOHNS HOPKINS UNIVERSITY

A HALF century program involving $16,350,000 for education and research at the Johns Hopkins University and the Johns Hopkins Hospital was announced to-day by Daniel Willard, president of the Baltimore & Ohio Railroad and chairman of the committee appointed by the trustees to finance a series of developments laid out in a survey begun in 1920 and undertaken in connection with the close of the university's first half century in 1926.

Toward this program $8,385,000 has already been raised, leaving a little less than $8,000,000 to be secured within the next twelve months.

The projects yet to be financed in the raising of the remaining $8,000,000 include a new chemical laboratory, an alumni memorial dormitory, general endowment for the academic and scientific departments of the university, endowment for the department of children's diseases, construction of a new central heating and power plant, construction of a new nurses' home, endowment for the School of Nurses, endowment for the Medical School, endowment for the hospital, construction and endowment of a new medical library and the construction and endowment of a new medical clinic.

The $8,385,000 which already has been contributed includes the following gifts: Eighty-five thousand dollars from graduates of the hospital's school for nurses for endowment of the school, $400,000 from the General Education Board for a pathological laboratory, $400,000 from Mrs. Lucy Wortham James for a woman's clinic, $2,000,000 from the Carnegie Corporation for a new dispensary, $2,000,000 from Mr. and Mrs. Henry Phipps, the General Education Board, Edward S. Harkness and interested Balti-

moreans for the Phipps psychiatric clinic, and $3,500,000 from the General Education Board toward the expansion program of the medical school.

The entire program outlined in the survey, which has been carefully prepared during the past four years, includes a series of projects which ultimately will involve $50,550,000—$16,450,000 for building developments and $34,100,000 for endowment—of which $13,300,000 is to be devoted to the academic and scientific departments of the university and $20,800,000 to the needs of the medical school, the hospital and the school of hygiene and public health.

The original gifts of Johns Hopkins, the founder, amounted to $6,450,356.88. The present assets include $23,857,021.84 for the university and $10,974,934.08 for the hospital. The university's endowment, $19,386,702.91, is the sixth largest in the country, exceeded only by those of Harvard, Columbia, Chicago, Yale and Stanford.

SCIENTIFIC NOTES AND NEWS

WE print in this issue of SCIENCE the address of Sir David Bruce, president of the British Association for the Advancement of Science now meeting in Toronto. The subjects of the addresses of the section presidents, some of which we hope to print, are as follows:

Mathematical and Physical Sciences. Sir William H. Bragg, Quain professor of physics, London University: "Crystal structure."

Chemistry. Sir Robert Robertson, chemist to the British Government: "Chemistry and the state."

Geology. Professor W. W. Watts, professor of geology, Imperial College of Science and Technology: "Geology in the service of man."

Zoology. Professor J. W. Gamble: "Construction and control in animal life."

Geography. Professor J. W. Gregory, professor of geography, University of Glasgow: "The relation of white and colored races in reference to white colonization in the tropics."

Economic Science and Statistics. Sir William Ashley, vice-principal University of Birmingham: "A retrospect of free trade doctrine."

Engineering. Professor G. W. O. Howe, professor of electrical engineering, University of Glasgow: "A hundred years of electrical engineering."

Anthropology. Dr. F. C. Shrubsall, principal assistant medical officer, London County Council: "Health and physique through the centuries."

Physiology. Dr. H. H. Dale, head of the department of biochemistry and pharmacology, Medical Research Council, London: "Progress and prospects in chemotherapy."

Psychology. Professor W. McDougall, professor of psychology, Harvard University: "Purposive action as a fundamental conception in psychology."

Botany. Professor V. H. Blackman, professor of plant physiology and pathology, Imperial College of Science, London: "The physiological aspects of parasitism."

Educational Science. Dr. Ernest Barker, principal of King's College, London: "The nature and conditions of academic freedom in universities."

Agriculture. Sir John Russell, director of the Rothamsted Experiment Station: "Present-day problems in crop production."

THE ninety-second annual meeting of the British Medical Association opened at Bradford, England, on July 22, when Dr. Basil Hall delivered his presidential address and the Stewart prize of £500 was presented to Professor E. Mellanby, of the University of Sheffield, for his work on the relation between rickets and dietetic deficiency.

FOR the newly organized American Society of Plant Physiologists, Dr. Charles A. Shull, of the University of Chicago, has been elected president; Dr. R. P. Hibbard, of the Michigan Agricultural College, vice-president, and Dr. R. B. Harvey, of the University of Minnesota, secretary-treasurer.

SIR WILLIAM POPE, professor of chemistry in the University of Cambridge, has been elected a foreign member of the Accademia dei Lincei of Rome.

ON the occasion of the centenary celebration of the Medical and Surgical Society of Bologne, held from May 23 to 25, a number of foreign members were elected, including Dr. Harvey Cushing, of Boston; Dr. John C. Hemmeter, of Baltimore, and Dr. William J. Mayo, of Rochester, Minn.

THE University of Maine has conferred the degree of Sc.D., *honoris causa,* upon Hugh K. Moore, chief chemist of the Broun Company, makers of paper pulp.

SIR ST. CLAIR THOMSON was recently elected president of the Royal Society of Medicine of London.

DR. J. H. JEANS, formerly lecturer at the University of Cambridge and professor of mathematics at Princeton University, has been appointed research associate at the Mount Wilson Observatory.

DR. GEORGE F. REDDISH, of the microbiological laboratory of the Bureau of Chemistry, has been appointed an associate bacteriologist to work on the bacteriological problems of the insecticide and fungicide board.

PROFESSOR WILLIAM HARMON NORTON, geologist, for forty-nine years a member of the Cornell College faculty at Mount Vernon, Iowa, has retired.

PROFESSOR GILBERT VAN INGEN, assistant professor of geology at Princeton University, is retiring from active service.

Edgar C. Bain, metallurgist and physicist, recently with the Atlas Steel Corporation, has joined the research staff of the Union Carbide and Carbon Research Laboratories, New York.

After a year spent in investigating race differences in the Hawaiian Islands, Dr. Stevenson Smith, of the department of psychology of the University of Washington, will return in August.

On July 17, Dr. Arthur T. Doodson, secretary of the Tidal Institute of the University of Liverpool, addressed the Association of Mathematicians of the Coast and Geodetic Survey on "Mean sea level and its fluctuations."

Dr. Wheeler P. Davey, of the Research Laboratory of the General Electric Company, gave twelve lectures before the graduate students of Pennsylvania State College during July.

The private scientific library of the late Professor Arthur Gordon Webster has been purchased by the Riverbank Laboratories, Geneva, Illinois, and is now housed there as a separate collection. The library comprises some twelve hundred volumes of works on mathematical physics and pure mathematics, as well as lecture and experimental notes, containing partially solved problems in which Professor Webster was interested.

The late Benjamin G. Lamme, formerly chief engineer of the Westinghouse Electric and Manufacturing Company, has left a fund of $15,000 to provide two scholarships for mechanical and electrical engineering courses at the Ohio State University. In addition, $6,000 is provided for a gold medal to be given annually to graduates for meritorious work in engineering and a similar medal for engineering teachers. A third medal will be awarded annually by the American Institute of Electrical Engineers to a member for advancement in the development of electrical apparatus.

Dr. John H. Dunlap, secretary of the American Society of Civil Engineers and formerly professor of hydraulics and sanitary engineering at the University of Iowa, died on July 29, aged forty years. Dr. Dunlap was injured on June 30 in the same railroad accident which caused the deaths of Dr. F. W. McNair and Dr. F. W. Ives.

Robert C. Sweetzer, professor of chemistry at the Worcester Polytechnic Institute, Massachusetts, died recently at the age of eighty-one years.

Dr. R. Kidson, the distinguished British paleobotanist, died on July 13.

Dr. R. H. Jude, for many years head of the mathematical and physical departments of Rutherford College, Newcastle-on-Tyne, England, died on June 1, aged seventy-one years.

The *British Medical Journal* states that two leading members of the Leningrad Academy of Military Medicine, Professor N. P. Krawkow and Professor Slowzow, both physiologists, recently died.

The Georgia House of Representatives has received a favorable report from its committee on education on a bill to withdraw all state funds from any school or other institution at which the Darwin theory or any other similar theory of evolution is taught. The bill is a copy of the Kentucky law.

According to a press despatch, Donald MacMillan, the Arctic explorer, with the schooner *Bowdoin*, has left winter quarters and has reached a point 187 miles to the south. As the *Bowdoin* spent the winter at Ellesmere Land, 11 degrees from the North Pole, her latest reported position is probably in the vicinity of Cape York, just northwest of Melville Bay, Greenland. The message said the *Bowdoin* would return home as soon as the ice fields, which were obstructing her progress, broke up.

Dr. Israel S. Wechsler, New York City, secretary of the American Jewish Physicians' Committee for the building of a medical school as part of the Hebrew University in Palestine, has left for London, to engage a medical director for the Microbiologic and Chemical Institute in Jerusalem, the first part of the proposed medical school to be inaugurated. Dr. Wechsler will then go to Palestine to supervise the immediate inauguration of this work.

Joseph F. Rock, leader of the National Geographical Society's expedition into Yunnan, China, has recently returned to the United States, bringing back some 1,700 specimens of birds, 500 mammal specimens and more than 60,000 plants, including a blight-resisting chestnut tree, which, it is hoped, will aid in restoring the diseased chestnut timber crop in the United States.

We learn from *Eugenical News* that a number of meetings of anthropological and eugenical interest will be held in Europe this summer. There was a "Semaine Anthropologique de Toulouse," July 21–27. The Twenty-first International Congress of Americanists will be held at The Hague from August 12 to 16, and in Göteborg, Sweden, from August 20 to 25. A meeting of the International Institute of Anthropology will be held at Prague the week beginning on September 14. Dr. Ruzicka is the organizing secretary at Prague. There is a section of eugenics. The third annual meeting of the International Commission of Eugenics will be held at Milan, from September 21 to 23, and in connection therewith there will be held a meeting of the Italian Society of Genetics and Eugenics from September 22 to 23.

The Imperial Botanical Conference opened at the

Imperial College of Science and Technology, South Kensington, on July 7. Sir David Prain, the president, in his opening speech, explained that the conference had been convened as a result of the evil effects of the great war on the quinquennial International Congresses which had been held prior to 1914. Over sixty overseas and British botanists were present at the meetings.

AN International Congress for Scientific Work was held in Prague from July 21 to 24 under the patronage of President Masaryck and the honorary presidency of Mr. Herbert Hoover.

THE International Astronomical Union is to hold its tri-annual meeting at Cambridge, England, beginning July 7, 1925.

THE Scottish Cattle Breeding Conference, held in Edinburgh from July 7 to 12, is said to be the first international meeting of its kind. Speakers from the United States included Dr. Raymond Pearl, of the Johns Hopkins University, and Dr. L. J. Cole, of the Bureau of Animal Industry.

THE fall meeting of the American Electrochemical Society is to be held at Detroit on October 2, 3 and 4. Electrolytic refining, corrosion, refractories for electric furnaces, industrial electric heating, electric furnace cast iron and analytical methods in electrodeposition will be subjects of symposiums or round-table discussions.

AN examination will be held on September 30 for senior economist (farm management) in the bureau of agricultural economics of the Department of Agriculture, at an entrance salary of $5,200 a year.

THE new buildings of the National Institute for Research in Dairying of University College, Reading, at Shinfield, were opened on July 19.

A NEW animal husbandry building to cost, fully equipped, more than $200,000 has been authorized by the building committee of the board of trustees of the North Carolina State College of Agriculture and Engineering.

THE building and grounds at 5750 Woodlawn Avenue, Chicago, valued at $45,000, have been given to the University of Chicago by the Cooperative Nursery Association for use as a nursery.

A CABLEGRAM from Leningrad to the daily press reports that more than 200 scientific men, explorers, geographers and their assistants left the city on July 18, under the auspices of the Leningrad Academy of Sciences to explore the island of Novaya Zemlya, in the Arctic Ocean north of Siberia. The expedition, which will operate under the leadership of Professor Matousevitch, will survey the geological, ethnical, geographical and other features of the island. At the conclusion of the work part of the party will proceed to the Straits of Matochkin Shar, which connect the Kara Sea and the Barents Sea, in an endeavor to find a safe passage for Russian merchant vessels.

THE *Journal* of the American Medical Association states that a special number of the *Riforma Medica* and of the *Radiochirurgia* gives illustrated descriptions of the gala proceedings celebrating the foundation of the university at Naples by Frederick II in 1224. Parties of delegates from many countries brought congratulations, and several national and international congresses closed the week. Among the Naples alumni whose names are familiar in our "Anatomies" is Domenico Cotugno or Cotunnius.

ACCORDING to an Associated Press dispatch, dated July 11, Russian archeologists who are excavating near Krasnoyarsk, Siberia, have unearthed several human bodies belonging to the Stone Age, a number of prehistoric mammoths, dinosaurs, bisons, gigantic stags and more than 700 stone and bone implements, ornaments and weapons of the prehistoric era. One of the human skeletons found by the explorers is believed to be at least 17,000 years old. The expedition was undertaken two years ago in an attempt to fix the place of the abode of prehistoric man in Siberia. It was working under the direction of Professors Auerbach and Sosnowsky, Russian archeologists.

THE first of a series of museums to be erected to serve visitors as an introduction and guide to the natural treasures of the national parks will be installed in Yosemite through an appropriation made by the Laura Spelman Rockefeller Memorial. The memorial will provide $50,000 for a building, $10,000 for equipment and $10,500 for salaries. The gift followed a suggestion by the American Association of Museums that the first be established in Yosemite and others be added to the Yellowstone, Lafayette, Petrified Forest and Mesa Verde national parks. Dr. Herman C. Bumpus is chairman of a subcommittee that will plan the museum and its exhibits.

A SMALL museum has been constructed in the Petrified Forest National Monument in Arizona in which many beautiful specimens of petrified wood have been installed. A gem cutter of Denver has offered to have polished many of the most perfect slabs in the collection. Plans are being considered for the installation of a small fountain in the museum, the basin to be filled with highly colored fragments of wood.

A LARGE stone building, valued at approximately $250,000, has been set aside by the National Park Service for a school of natural history for tourists in the Yellowstone National Park. The first summer session will be held at Mammoth Hot Springs, beginning in June, 1925. Funds and equipment are being

collected by Professor R. B. Harvey, of the University of Minnesota. Due to the favorable arrangements made by the government, it is expected that cost of attendance will be kept very low, and that considerable numbers of students will avail themselves of the opportunities afforded to combine natural history training with a summer outing.

UNIVERSITY AND EDUCATIONAL NOTES

Western University Faculty of Medicine, of London, Ontario, will receive bequests amounting to $110,000 under the will of the late Dr. F. R. Eccles, who for many years was dean of the faculty of medicine of the university.

Dr. John Purser, Regius professor of physics at Trinity College, Dublin, has given to the university £10,000 to be used for the benefit of the school of physics and the schools of experimental and natural science.

University College, London, will celebrate the one hundredth anniversary of its foundation next year.

The new Seoul Imperial University Medical School is completed and will be opened in the near future. Dr. K. Shiga has been appointed dean of the school.

Dr. Victor C. Myers, professor and director of the department of biochemistry, New York Post-Graduate Medical School and Hospital, has resigned to accept the appointment of professor of biochemistry at the State University of Iowa and pathologic chemist to the University Hospital.

Dr. Arthur I. Kendall, dean of the Northwestern University Medical School, has been appointed director of the department of bacteriology and hygiene at Washington University Medical School, St. Louis.

Dr. H. P. K. Agersborg, instructor in biology at Williams College, has been appointed professor of biology and head of the department, at the James Millikin University, Decatur, Illinois.

Dr. L. Grant Hector, Tyndall fellow in physics at Columbia University, has been appointed assistant professor of physics in the University of Buffalo.

Dr. George Johnson, professor of zoology at the University of Mississippi, has been appointed professor of zoology at the University of Kansas, to take the place of Dr. F. L. Hisaw, who has accepted a position at the University of Wisconsin.

Edward Arthur Milne, assistant director of the Solar Physics Observatory at the University of Cambridge, has been appointed to the Beyer chair of applied mathematics at the University of Manchester.

QUOTATIONS

SOME REMINISCENCES OF LORD KELVIN

It is of interest at the present time to recall that Lord Kelvin, Sir George Stokes and Professor Huxley were elected fellows of the Royal Society in the same year and on the the same day, namely, June 5, 1851. Each of this brilliant triumvirate lived to receive the honor of the presidency, in 1883, 1885 and 1890, respectively. The certificate of candidature of Lord Kelvin (William Thomson) was signed by Michael Faraday, John Couch Adams and Adam Sedgwick, the distinguished Woodwardian professor of geology in the University of Cambridge. In retrospect, the support of Sedgwick is especially interesting since we know, through Sir Archibald Geikie, that from the year 1844 onwards for some eighteen years Lord Kelvin watched with increasing impatience the spread of the doctrines of the Uniformitarian School in geology, and at length, in 1862, "broke silence on the subject, declaring the doctrines of that school to be opposed to physical laws." It was one of the accepted tenets of the Uniformitarian School that the range of past time available for the explanation of the phenomena of geology was unlimited; but by arguments drawn from the origin and age of the sun's heat, the internal heat and rate of cooling of the earth, and the tidal retardation of the earth's rotation, Lord Kelvin fixed limits to the possible age of our planet. These have, of course, more recently been disputed. Lord Kelvin was always most punctilious in correspondence. Following the onerous engagements incidental to the celebration of his professional jubilee at Glasgow in 1896, he occupied himself on the way to London in writing autograph acknowledgments of the congratulation of friends. Not a few of his distinctive shorter papers were composed during railway journeys between Glasgow and London. In fact, wherever there was motion he found an atmosphere of calm, the hum of machinery acting as a mental stimulus. Mention may be made here that Lord Kelvin's portrait, by Orchardson, hangs in the Royal Society's meeting-room, the gift of a circle of fellows.—*Nature.*

EVOLUTION IN GEORGIA

By a vote of 13 to 0 the Committee on Education of the Lower House of the Georgia Legislature has reported favorably a bill which would withhold state support from any school or university in which the doctrine of evolution is accepted for study. The down-with-evolution movement, which began in the border states some three years ago, moves eastward to the seaboard. The Georgia Legislature is likely, by all reports, to enact the measure. A majority of Georgians seem to want to suppress evolution once for all.

For a time this attitude on the part of border

Southerners was more amusing than anything else. It appeared incredible that any body of mature citizens of the United States could seriously dispute the scientific explanation of the origin of species. But the matter has gone, like the Ku Klux Klan, far beyond a joke. There are communities and states in this country which have not caught up with the England of 1875 in their thinking.

It is, of course, no crime to hold evolution to be an invention of the devil for corrupting souls. It is no crime to believe the earth flat, a belief long held in much the same positive manner. There was a famous Negro preacher who made his stand for righteousness on the assertion that "the sun do move and the earth am square," proving his faith by Biblical quotation. It is only regrettable that the children who must get their schooling in backward communities must absorb so much darkness along with their A B C's.—*New York World.*

DISCUSSION AND CORRESPONDENCE

EDWARD HITCHCOCK AND THE ORIGIN OF THE ASSOCIATION OF AMERICAN GEOLOGISTS

PROFESSOR FAIRCHILD, in his historical sketch of the American Association for the Advancement of Science, in SCIENCE for April 25, 1924, mentions the various conflicting views in the early accounts touching the priority of suggestion for calling a conference of American geologists.

In a paper on Edward Hitchcock, read at a meeting of the Science Club of Amherst College a few years since,[1] the present writer expressed the following opinion:

To Hitchcock, more than to any other man, is due the title of founder of the Association of American Geologists—the forerunner and parent of the American Association for the Advancement of Science. The first written suggestion in regard to the formation of this association came from him. At a meeting held at the rooms of the Franklin Institute in Philadelphia, on April 2, 1840, the association was organized, and he was chosen president, being the first of a long line of American savants to receive this distinction.[2]

As early as 1837, and possibly earlier, Professor Hitchcock had approached the leading American geologists and a few other scientists in regard to his "hobby," namely, "a meeting of our geologists." The letters and passages cited below, relative to the genesis of the parent society, show this and are also in accord with the suggestion in Mather's letter to Emmons, respecting a conference, " but saying that he had received the idea from Edward Hitchcock."

Professor Hitchcock, Dear Sir: I received, a few days since, the Proceedings of the American Association for the Advancement of Science, first meeting, held in Philadelphia, September, 1848; and in it, page 91, I found a letter from Professor Hall, and observed with some surprise the latter part of the sentence of the second paragraph, (relating to Professor Vanuxem), *viz.*: "and to whom is due, above all others, the honor of being the first man to propose such an organization." Now I do not wish to detract at all from the merit due to Professor Vanuxem; and perhaps Professor Hall made the representation from memory only, or from hearsay, on the spur of the occasion; but that which belongs to the history of the Association of American Geologists ought, if stated where it will be referred to, to be stated accurately. *You* know that he was not the first to propose such an organization in 1838.

In 1837 I received a letter from you on this subject. . . . On the 12th of October, 1838, you wrote me at Albany, . . . in which you say: "And I had also hoped that ere this a meeting of American Geologists would be brought about in New York or Philadelphia; but I feel that I am to be disappointed in this also." It gives me much pleasure to see you express a wish to compare notes with others in relation to geological observations. I think it is much to be regretted that there is not greater harmony of feeling, unity of action and interchange of opinions and observations among our geologists. *You,* so far as I know, first suggested the matter of such an association. I laid the matter before the Board of Geologists of New York, specifying some of the advantages that might be expected to result; and Professor Vanuxem probably made the motion before the Board in regard to it, which may have been all that Professor Hall knew about it. We can each of us well dispense with the honor that might be awarded for originating the matter in one case, and putting in train for execution in the other: still, where the origin of an important society and association of scientific men for the advancement of science is recorded in its memoirs as historical fact, it ought to be stated *correctly.*[3]

In a letter of Edward Hitchcock[4] to Henry D. Rogers, at that time in charge of the geological survey of Pennsylvania and New Jersey, dated Amherst, Mass., April 4, 1838, Professor Hitchcock says:

I want that you, with such other geologists as you choose to associate with you in Philadelphia and New York, should forthwith appoint a time and place and issue a circular summoning a meeting of our geologists. And it seems to me important that this should be done

[1] *The Amherst Graduates' Quarterly,* Vol. X, 1920, p. 1.

[2] Hitchcock's address as retiring president, "on the most important points in American geology," was first printed in full in the *Amer. Journ. Sci.* Vol. 41, 1841, pp. 232–275.

[3] Letters of William W. Mather to Edward Hitchcock.

[4] "Life and Letters of William Barton Rogers," Vol. I, p. 154.

this spring, before the state geologists take the field for another campaign. Let each man be invited to bring with him any specimens he may wish to be examined, and let it be understood that several days will be spent together, and if you think proper, that an association will be formed. Perhaps one or two public lectures might be given during the meeting, or some of the discussions be made public. I feel so strong a hope that you will listen to these suggestions that I will venture to name the individuals in New England whom I think it would be desirable to invite; some of them I have seen within a few days past, and they express a deep interest in such a plan: Professor Silliman, Professor Shepard, Dr. Percival, New Haven; Dr. C. T. Jackson, George B. Emerson, President of the Natural History Society, Professor Charles B. Adams, Boston; Dr. Samuel L. Dana, Lowell, Mass.; Professor Cleveland, Brunswick, Maine; Professor Hubbard, Dartmouth College, Hanover, N. H. I suppose that New York or Philadelphia would be the proper place of meeting.

Five months later, on September 26, 1838, Henry D. Rogers[5] writes his brother William as follows:

The chief part of to-day I have spent in company with Professor Hitchcock, who, making a brief visit to the city, called on me. . . . He is very impatient to witness a summoning of the geologists into an association, and says those of New England will obey the call most cordially. He thinks we should commence it here or in New York. What say you to our trying it for next spring and in Philadelphia? Take this into grave consideration, and give me your suggestions as to whether it were better to delay the movement until a general association for all the sciences can be brought about, or to make it now for geology merely.

There is also before me a letter of Benjamin Silliman to Edward Hitchcock, dated August 18, 1838, to whom the latter had written urging the formation of a geological society. "I am not courageous enough to convoke the geologists," writes Professor Silliman —"like the bachelor who said he admired exceedingly the courage of those who dared venture on matrimony —but he was himself too timid. I am informed from very good authority that so far from coming at my call there is a spirit in Phila. to call the other way and that a journal is projected to supersede mine— *Nous verrons.*"

Edward Hitchcock was also an original member of the earlier organization, the American Geological Society, which held its first meeting on September 6, 1819, in the Philosophical Room of Yale College. At that meeting William Maclure was chosen president, and Edward Hitchcock one of three corresponding secretaries. He was subsequently, 1824–26, a vice-president of the society.

Frederick Tuckerman

Amherst, Massachusetts

[5] *Op cit.*, p. 155.

BALL LIGHTNING

I am trying to learn something about ball lightning. In fact, I have just read a whole book about it, but, like Faust, am almost as wise as when I began. Please, therefore, you who have seen this strangest of meteors, tell me all about it: By whom seen; whether others also saw it; when (date) and where (geographic location); stage (beginning, middle or close) of storm; indoors or out; if indoors, how it came in and how it departed; single or many; duration; color; size; shape; nature of outline (sharp or blurry); noise; odor; fixed in position or moving; if moving, whether with or independent of wind; direction of motion (vertical, inclined or horizontal); velocity; kind of motion (smooth or jumpy); and effects produced; also anything else that was observed in connection with it.

Most cases of ball lightning aren't, but some are; and we want to understand the cause and nature of this rare phenomenon. But that understanding can be had only from a collection of accurate descriptions of the appearance and behavior of the thing to be explained. Hence this appeal, to which early and full responses are earnestly requested.

W. J. Humphreys

U. S. Weather Bureau
Washington, D. C.

SCIENCE AND INDUSTRY

The distinguished industrial chemist who writes in your issue of July 4 (page 16) on the relative worthiness of pure and applied science may find himself not out of sympathy with the Napoleonic officer who was discussing with a Prussian colleague the merits of their respective nationalities. It was a time when things were not going very well for the Prussian's cause, and he compensated for this by claiming that the Prussians fought for honor and glory, while the French fought only for money. "True enough," replied the veteran of Marengo and Jena, "each one of us fights for what he needs the most."

Less superficially, is it not the chief rationale of pure science that it is the underpinning of technology? Where would man's so-called mastery of nature be if we took away the results of fundamental research? The land of Erewhon would be soon o'erpassed. Pure science is to technology as root is to blossom, and one might as well ask which of these two is the more important or "respectable." Fundamentally, the sincere worshipper at either shrine is not there because of its greater venerability, but because he is so constituted as to get his satisfaction from that particular kind of mental activity. Each one works for what he wants the most—*de gustibus.*

F. L. Wells

Boston Psychopathic Hospital

SCIENTIFIC BOOKS

Ninth Report of the Committee for the Investigation of Atmospheric Pollution. Report on Observations in the year ended March 31, 1923.

ABSTRACTS of the reports of previous years are to be found in SCIENCE, June 2, 1922, April 22, 1921, and November 28, 1919. The present report, both comprehensive and satisfactory, makes it plain that the Advisory Committee on Atmospheric Pollution, appointed in 1912, as a result of agitation by the Coal Smoke Abatement Society, is an effective body accomplishing much good work. Primary purposes have been achieved and scientific measurements of atmospheric impurity obtained. There remain for future investigation the problems of distribution in a vertical direction, the relation of dust to visibility, impurity and health, and acidity of the air.

The present report of 59 quarto pages gives details of the work. Four of its six sections deal with records from instruments developed under the committee's auspices. Two sections deal with certain experimental inquiries. Three methods of examination are in common use:

(1) A standard gauge measuring the total impurities in a month over a measured area. The total is analyzed into insoluble and soluble, tar and other carbonaceous matter and ordinary wind-borne inorganic dust.

(2) An automatic filter which isolates samples of impurities near the edge of a circular disc of filter paper at intervals of two hours or more.

(3) The jet dust counter (Owens). Here a limited volume (50 cubic centimeters) of air is pushed rapidly through a slit and the dust deposited on a cover glass of small cross section, to be examined microscopically.

All these instruments are now manufactured commercially, and whoever wishes to study air purity can purchase and determine for himself.

The amount of impurity as determined by the jet dust counter ranges from 80,000 particles per cubic centimeter during a thick fog to a few hundreds, or even a hundred during clear air. It takes about 10,000 particles per cubic centimeter to make a milligram of dirt per cubic meter.

One of the problems on which some progress has been made is the relation between transparency or visibility, as it is commonly called, and the amount and nature of the impurity. Two methods of measuring transparency, both novel, have been tried. In the first, a uniformly illuminated surface has its optical brightness at different distances measured with an ordinary photometer. In the second, a specially designed photometer is placed in the beam of a searchlight and a comparison made of the illumination of the mirror with that of a black stop placed in front. This is known as the contrast photometer, designed by Mr. L. F. Richardson. By it, changes in the transparency of the atmosphere which are constantly occurring can be readily detected and measured; and as simultaneous observations by filter and by dust counter can be made, one can get a good idea of the efficiency of the dust and other particles in diminishing transparency. We do not, however, know the relation between water droplets which form the bulk of the obstruction of clouds and the hygroscopic dust particles which are so necessary in the formation of clouds.

Regarding the results obtained with the automatic filter, the observations of the past year confirm the concentration of suspended impurities between 10 A. M. and 6 P. M. and comparative purity between midnight and 6 A. M. Of course there are some contradictory results.

The International Union for Geodesy and Geophysics, meeting at Rome in 1922, purchased sixteen jet dust counters; and these were sent to Meteorological Bureaus at Rome, Paris, Stockholm, Japan, Lisbon, Bucharest, Poland, Athens, London, Toronto, Rio de Janeiro, Madrid, Washington, Belgium, Melbourne and Pavia. The London records show that during a smoke fog, 20,000 to 50,000 particles per cubic centimeter were present. There appears to be a tendency for particles to attain a maximum size during heavy smoke fogs, while during the lighter hazes the particles are usually much smaller. Probably the densest fog of the winter in London was on January 17, 1923. The number of particles per cubic centimeter at 11:15 was about 53,000, the diameter varying from 1.5 microns down. There were numerous crystals visible in the record. Incidentally we note that records obtained from tobacco smoke show nothing but transparent yellow oily deposit, free from solid particles.

One other interesting statement is that during a heavy smoke fog in London, one would breathe in 24 hours of such fog 500,000,000,000 particles of suspended matter. Their size is such that if placed in contact these would form a string of about 250 miles in length. "This way of looking at the degree of pollution," says the committee, "gives some idea of the work which must be done by the cilia and cells of the respiratory organs to remove the impurities breathed in."

Space does not permit reproduction of the various illustrations; also the somewhat extended discussion of the origin of the spherical particles (probably of volcanic origin) and of the hygroscopic nuclei.

Mention should be made of the use of the jet counter by Kimball and Hand (*Monthly Weather Review,* March, 1924) in determining the number of dust particles at various levels, in airplanes piloted by Air Service officers from Bolling Field.

The writer of this note has also used an Owens jet dust counter in connection with artificial lightning, through the courtesy of Dr. Peek of the General Electric Company in the high tension laboratory at Pittsfield. Discharges three meters long, with voltage of over one million and amperage of 100,000, were employed. The slides do not, however, show the marked clarification of the air which was expected; but the experiments are not made in free air. Observations before and after real lightning flashes are under way at Blue Hill Observatory.

ALEXANDER MCADIE

SPECIAL ARTICLES

SENSITIVE FLAMES AND APPARENT FLAME PRESSURE[1]

ADJUSTMENT

THE disposition of apparatus is shown in figure 1, where *UU'* is the interferometer U-gauge, *r* and *s* the reentrant and salient pin holes, *t* the quill tube and *F* the fine conical gas jet about 1 mm in diameter (salient outward) for the sensitive flame. *F* is preferably placed vertically. The gas inlet *G* is at the middle of *t* so that *r, s* and *F* may function as nodes. *G* is provided with a stop cock to vary the gas pressure. Since this pressure acts at both *U* and *U'*, it is only the acoustic pressure due to vibration within the quill tube which will influence the gauge, *U, U'*.

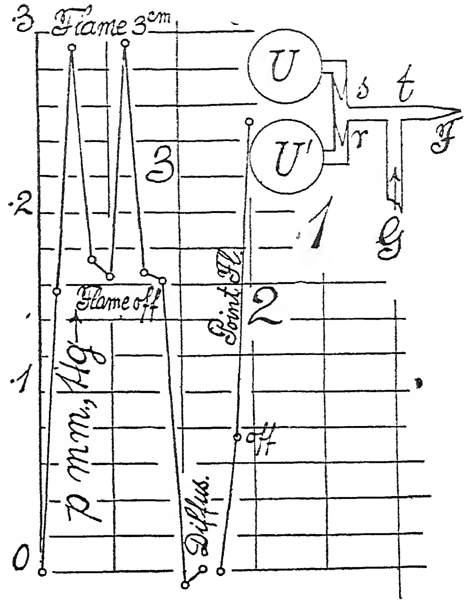
The pin holes *r s* are rarely quite of the same diameter. Hence the fringes will move for any sudden change of pressure at *G*, temporarily; but they soon return to zero. The flame *F* was very sensitive; but no acoustic pressure under any conditions could be observed. There was no effect even when the flame was purposely made turbulent by high gas pressure. This was also the case in a variety of other devices. Thus the sensitive flame phenomenon must be considered to exist outside of the quill tube *t F* and there is no corresponding vibration within.

TELEPHONIC EXCITATION

On removing *t* from *r s* and the gauge and joining it to a telephone excited by a little induction coil with a break of variable pitch, one gets a beautiful exhibition of König's flames at *F*. In this case a small sharp flame, 2 or 3 cm or less, is of course desirable. However, the attempt to detect the resonances in the quill tube in this way failed.

FLAME PRESSURE

Joining the quill tube *t* with the shank *U* only (*s*, figure 1, may be left in place as it does not function, *r*, also inactive, may be open to the atmosphere), one observes an increased pressure within *t*·(caet. par.), whenever the flame *F* is ignited. These pressures are in excess of the normal registry of the gauge so that small flames (from a point like a split pea to 2 or 3 cm) only, are to be used. Figures 2 and 3 give examples of the results. The curve, Fig. 2 (points spaced horizontally to show different conditions), beginning with no pressure (mm of mercury) when the cock is closed, registers about .075 mm with the gas cock just open, owing to the resistance at the jet, and .25 mm after the flame is lit. The point flame, therefore, acts like a stopper, virtually narrowing the jet. Figure 3 gives a more extended series, with a flame 2–3 cm long. Hence the gas pressure at *t* in the absence of flame is larger, about .16 mm. With the flame lit, the pressure reaches nearly .3 mm. It is not, however, as much larger as in the case of the point flame. When the flame is blown out the intermediate gas pressure is restored, first at a rapid rate, finally very gradually, the progress obviously corresponding to a case of cooling of the mouth of the jet. The phenomenon is remarkably steady and the experiment may be repeated indefinitely, two cases being given in figure 3. When the gas is finally shut off, the fringes dip below zero, which however is regained in the lapse of time. This is optic evidence of the diffusion of hydrocarbon gas into the U-gauge and of the subsequent diffusion outward.



REMARKS

I was at first inclined to believe that an actual pressure increment within the flame locus had been ob-

[1] Advance note from a Report to the Carnegie Institution of Washington, D. C.

served. What happens, however, is probably no more than a large increase of the viscosity of the gas at the jet. Because of the high temperature there, the jet with the flame lit temporarily conveys a much more viscous gas current. Thus the asymptotic cooling effects in figure 2 are accounted for (hot jet tube) as well as the striking steadiness of the phenomenon when the flame is on, and the disproportionately great effect of point flames. For in the latter, the colder blue base is lacking.

It follows from the above that if for any reason the flame is removed, there is an instantaneous excessive outrush of gas from the jet. When the flame is restored, this excess is at once cut off. Here then is a mechanism that contributes to periodic motion of flame and must be effective in turbulent flames. Since pin holes are sensitive at nodes, I have supposed that temperature occurrences might here be effective also; but this can not be the case in a phenomenon which is symmetrically either positive or negative, depending on the slope of the pin hole.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

THE ROYAL SOCIETY OF CANADA

AT the annual meeting of the Royal Society of Canada, held in the city of Quebec, on May 19, 20, 21 and 22, the following papers were presented in Section V:

SECTION V—BIOLOGICAL SCIENCES

Presidential Address

Historical review of the red discoloration of foodstuffs: F. C. HARRISON.

Botanical

Luminous leaves: A. H. REGINALD BULLER.

Sphaerobolus stellatus and the dispersion of its spores by herbivorous animals: A. H. REGINALD BULLER.

The fresh-water algae of Central Canada: C. W. LOWE (presented by A. H. REGINALD BULLER).

Identity of the organism causing black-rot disease of the potato—Part I: B. T. DICKSON and G. A. SCOTT (presented by F. C. HARRISON).

Identity of the organism causing black-rot disease of the potato—Part II: B. T. DICKSON and G. A. SCOTT (presented by F. C. HARRISON).

The effect of various smut control treatments on the germination of oats: B. T. DICKSON and W. L. GORDON (presented by F. C. HARRISON).

The bacteriology of the Kingston cheese: C. D. KELLY (presented by F. C. HARRISON).

A study of the moulds in blue-veined cheese: N. S. GOLDING (presented by F. C. HARRISON).

Microbiological relationships in frozen soils: A. G. LOCHHEAD (presented by F. C. HARRISON).

Psychrophilic soil bacteria: A. G. LOCHHEAD (presented by F. C. HARRISON).

The toxic action of distilled water and the antagonism to it of cations: G. W. SCARTH (presented by F. E. LLOYD).

General

The origin of karyokinesis: A. B. MACALLUM.

Medical

After-effects of feeding thyroid to young rats: A. T. CAMERON and J. CARMICHAEL.

The action of absorbable intestinal toxins on metabolism: A. T. CAMERON.

The cranio-facial axis of Huxley—Part I, embryological considerations: JOHN CAMERON.

A further study of the question of utilization ("fermentation") of saccharose by B. diphtheriae: J. G. FITZGERALD and DOROTHY G. DOYLE.

The effect of insulin on the percentage of sugar in blood from different regions of the body: J. J. R. MACLEOD, J. HEPBURN, J. K. LATCHFORD and N. A. MCCORMICK.

The influence of insulin on the glycogen content of the liver and muscles during hyperglycemia: J. J. R. MACLEOD, E. C. NOBLE and M. K. O'BRIEN.

The soluble carbohydrates of liver and muscle and the influence of insulin on them: G. S. EADIE, J. J. R. MACLEOD and M. D. ORR.

Further observations on depancreatized animals: F. N. ALLAN and S. S. SOKHEY (presented by J. J. R. MACLEOD).

The effect of insulin on chloridzin diabetes in dogs: S. U. PAGE (presented by J. J. R. MACLEOD).

The behavior of the diastases in diabetic animals treated with insulin: J. MARKOWITZ (presented by J. J. R. MACLEOD).

Viscero-motor reflexes: FREDERICK R. MILLER and H. M. SIMPSON.

Pulse and cardiac records obtained with electropolygraph: FREDERICK R. MILLER and R. A. WAUD.

Amplification of heart sounds by radio apparatus: G. A. RAMSAY (presented by FREDERICK R. MILLER).

Classification of tumors arising from the trophoblast with illustrative cases: JAMES MILLER.

Zoological

Acaulis primarius Stimpson: C. MCLEAN FRASER.

Some results of the Belle Isle Strait Expedition, 1923: A. G. HUNTSMAN.

The distribution of pile borers on the Canadian Atlantic coast: R. H. MCGONIGLE (presented by A. G. HUNTSMAN) (read by title).

Certain features in the life-history of the shad: A. H. LEIM (presented by A. G. HUNTSMAN) (read by title).

Resistance of marine animals to high temperatures and their distribution in nature: A. G. HUNTSMAN and M. I. SPARKS (read by title).

A list of the nudibranchiate mollusca recorded from the Pacific coast of North America, with a note on their distribution: CHARLES H. O'DONOGHUE (read by title).

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CONTENTS

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THE ANALYSIS OF CRYSTAL STRUCTURE BY X-RAYS[1]

In this address I propose to consider the new methods of analyzing the structure of materials by means of X-rays, considering especially the stages by which they move towards their objective. It is convenient to recognize three such stages, of which the first comprises the simplest and most direct measurements and the last the most indirect and complex.

The fundamental measurement of the method is the angle at which rays of a given wave-length are reflected by a set of planes within the crystal. The planes of a "set" are all exactly like one another: an imaginary observer within the crystal could not tell by any change in his surroundings that he had been moved from one plane to another. Sometimes there is no reflection of the first order from a set so defined, because the planes may be interleaved by other planes so spaced and of such strength as to annul the true reflection; but this can always be allowed for. When the wave-length of the X-rays is known, the angular measurement can be used to find the spacing of the set of planes, and in this way a linear dimension of the crystal is measured. The spacing is the distance between any plane and its nearest like neighbor on either side. If the spacings of three different sets of planes are found, the volume of the unit cell is found. The crystal unit cell is bounded by six faces, each set of planes furnishing a pair. The pair consists of two neighboring planes of the set. The cell may have a great variety of forms, but has always the same volume. The specific gravity of the substance being known, it is possible to find the number of atoms of various kinds which the cell contains; the proportion of the various kinds is necessarily the same as in the molecule of the substance. The cell is in practice found always to contain a small integral number of molecules, one, two, three or four, rarely more. This assemblage of molecules is fully representative of the crystal; by the mere repetition of the cell, without the addition of any new features, the crystal with all its properties is produced.

There are, therefore, three types of assemblage. The simplest is that of the single atom, as in helium in the gaseous state, in which the behavior of every atom is on the whole the same as the behavior of any other. The next is that of the molecule, the smallest portion of a liquid or gas which has all the properties

[1] Address of the president of Section A—Mathematical and Physical Science of the British Association for the Advancement of Science, Toronto, August 11, 1924.

of the whole, and lastly, the crystal unit, the smallest portion of a crystal (really the simplest form of a solid substance) which has all the properties of the crystal. There are atoms of silicon and of oxygen; there is a molecule of silicon dioxide, and a crystal unit of quartz containing three molecules of silicon dioxide. The separate atoms of silicon and oxygen are not silicon dioxide, of course; in the same way the molecule of silicon dioxide is not quartz; the crystal unit consisting of three molecules arranged in a particular way *is* quartz.

The final aim of the X-ray analysis of crystals is to determine the arrangement of the atoms and the molecules in the crystal unit, and to account for the properties of the crystal in terms of that arrangement.

The first step is the determination of the dimensions of the crystal unit cell: any one of the possible ways in which the cell can be drawn will do. When this has been completed it is a simple calculation in geometry to find the distance between any atom and any other atom in the crystal of like kind and condition, or, in other words, the distance an observer would have to travel from any point within the crystal to any other point from which the outlook would be exactly the same and would be similarly oriented. This is the only measurement which the X-rays make directly; any other measurement of distance is made indirectly, by aid of some additional physical or chemical reasoning. It is not possible by direct X-ray measurement to determine the distance between any two points—atom centers, for example—within the same cell.

Let us take an example. The crystal unit of naphthalene has the dimensions defined in the usual way by the statement:

$$a = 8.34\text{Å} \quad b = 6.05\text{Å} \quad c = 8.69\text{Å}$$
$$\beta = 122^\circ\ 49' \quad \alpha = \gamma = 90^\circ.$$

It contains two molecules: an integral number, as always. These facts are given directly by the X-ray measurements. But there is no direct determination of the distance between any carbon atom and any other carbon atom contained within the same cell; the measurements given are those of the distances between any atom and the nearest neighbors, in three principal directions, which are exactly like itself, these distances being the lengths of the edge of the cell. There is not even a measurement of the distance between the two molecules in the same cell, because they are not similarly oriented. In fact, there is no clear meaning in the term "distance" in this case, just as we can not state the distance between an object and its image in a mirror, unless the object is a point of no dimensions. If the molecule of naphthalene has a center of symmetry, as is indeed indicated during the development of the results of the X-ray analysis, it is possible to state the distance between the centers of symmetry of the two molecules in the same cell, but this does not define the distance between any atom in one of the two molecules and any atom in the other. All such distances, if they are to be defined and measured, can only be found by the aid of fresh considerations.

Or again, let us take the case of rock-salt. The crystal unit cell of rock-salt contains one molecule; one form of the cell has for its eight corners the six middle points of the faces of a certain cube (edge $= 5.62$ A.U.) and two of the opposite ends of any diagonal of the cube. The so-called face-centered cube is four times as large as the cell and contains four molecules. The dimensions of the cell are determined directly by the X-rays, which measure the distance between each of the three pairs of parallel faces that contain it. The cell may be placed so that each corner of it is associated in the same way with a molecule of sodium, let us say: and, of course, the knowledge of the dimensions of the cell is equivalent to a knowledge of the distance between any two sodium atoms in the crystal, which atoms are all alike in every respect. But we have no direct measurement by the X-ray methods of the distance between a sodium and a chlorine atom. We infer that the chlorine atom lies at the center of the sodium cell, or *vice versa,* from considerations of symmetry. Crystallographic observations of the exterior form of the cell assign to the crystal the fullest symmetry that a crystal can possess. If the cell that has been described is to contain the elements of such full symmetry, the chlorine atom must lie at the center of it. It can not lie anywhere else, for every cell would contain a chlorine atom similarly placed. There would then be unique directions in the crystal; that is to say, polarities. Moreover, both the sodium and the chlorine atoms must themselves contain every symmetry of the highest class: the full tale of planes of symmetry, axes of rotation, and so on. They both have centers, and we can state the distance between a chlorine atom and a sodium atom because we can state it as between center and center, and put it equal to half the distance between two sodium atoms on either side of the chlorine. The structure of sodium chloride is then determined completely.

It may possibly be a difficulty that the cell so described does not at first appear to have all the symmetries of the rock-salt cube, but it is to be remembered that we are to expect the full display of symmetries only when the cell has been repeated indefinitely in all directions. We may take a simple case, as in Fig. 1.

Suppose sodium and chlorine atoms were to be arranged in a line as in the figure, just as they are in

any of the three principal directions in the crystal. A plane of symmetry perpendicular to the line of atoms indefinitely prolonged may be drawn through the center of any atom. The unit cell is one molecule: one chlorine and one sodium. The unit by itself has not this symmetry, but the repetition of the same

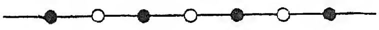

Fig. 1

molecule in either direction on either side provides the symmetry. Moreover, each sodium and each chlorine must itself have a plane of symmetry, and the planes are equally spaced. We can state the distance between a sodium and a chlorine atom as half the distance between two sodiums.

Let us take one more instance, the diamond. The crystal unit cell contains two atoms of carbon: as in the case of rock-salt, it may be so chosen that, of its eight corners, six are the middle point of the faces of a certain cube and two are the ends of any diagonal of the cube. The sides of this cell are determined by the X-rays, and are all equal to 2.52 A.U. This is the distance between any carbon atom and the nearest carbon atom which is exactly like itself. The distance between the two carbon atoms in the same cell is not measured directly, but can be inferred after it has been defined. This we are able to do because the carbon atom is tetrahedral; a tetrahedron has a center, and we can state the distance between the centers of two tetrahedra, no matter how the tetrahedra are oriented. We know that the carbon atom, as built into the crystal, is tetrahedral, because the X-ray observations show that the four trigonal axes meet in it. The two atoms in the cell are oriented differently; one may be said to be the image of the other, if translation shifts are ignored, in each of the faces of the cube. Considerations of symmetry or X-ray observations show that the center of an atom of the one orientation lies at the center of a tetrahedron formed by four atoms of the other orientation. The edge of this tetrahedron is the edge of the unit cell, and its length is 2.52 A.U. It may then be calculated that the distance between the one atom and the others, its nearest neighbors, is 1.54 A.U. We may call this distance the diameter of the carbon atom, but we must remember our original definition of the meaning of the term. Thus the 2.52 A.U. is the result of a direct unaided X-ray measurement, but the 1.54 A.U. is not, and has no meaning except after special definition.

Only such distances between atoms as can be calculated from the dimensions of the unit cell can be measured directly and without qualification. The determination of these distances may be looked on as the result of the *first stage* of the analysis by X-rays.

We now come to a *second stage*. It is possible to make other statements of the relative positions of atoms and molecules which, though less complete and informative than those of distances, and their orientations, are necessary to the solution of the crystal structure problem. These also are deduced by means of the X-ray methods.

It often occurs that the atoms or molecules in one cell can be divided into two portions which are the reflections of one another across some plane, or can be brought to be the reflection of each other by a shift parallel to the plane. In that case the orientation of the plane and the amount of the shift can be stated definitely, the former by inspection of the crystal or by X-ray observations, the latter by X-ray observations alone. So also it may happen that the atoms or molecules in the same cell may be divided into portions which can be made to coincide with each other by a rotation round some axis with or without a shift parallel to that axis. The direction of the axis can be found by inspection of the crystal or by X-ray observations; the amount of the shift can be found by X-ray observations alone.

In these cases the distances that are found by the X-ray method are all that can be stated without special definition. It is not possible to state the distance between an object and its image in a mirror, if the object has any extension in space; but it is possible to state the magnitude of a shift.

Measurements of this sort constitute a characteristic feature of the X-ray analysis, for which reason I would like to discuss them briefly.

We know that it is possible to separate crystals into thirty-two classes, according to the kind of external symmetry which they display. As we have hitherto been unable to look into the interior of the crystal, we have been obliged to be content with this imperfect classification by outer appearance. It has been shown, however, that there is a classification by inner arrangement which is perfect and includes the other. It is beyond the limits of ordinary vision: out of the range of the lens and the goniometer. The interior arrangements of the crystal, of which the outer form is one consequence, are so varied as to furnish 230 different modes. With very few exceptions the X-rays now allow us to carry the classification to this higher degree. If the modes are grouped according to the external features of the crystals that follow them, we come to the well-known thirty-two classes, there being several modes in every class. I may be permitted to illustrate this important point by examples, although it is familiar to those who have studied crystallography. Let us consider

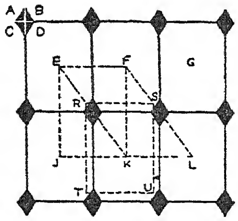

FIG. 2.

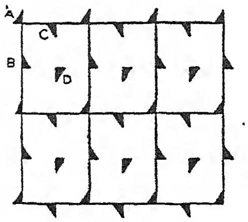

FIG. 4.

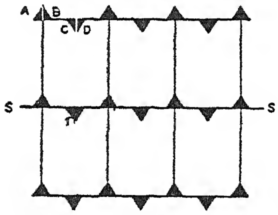

FIG. 3

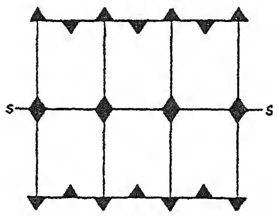

FIG. 3A.

first a two-dimensional example, which is much easier to describe than the three dimensional actuality, and contains all the essential ideas.

Consider an arrangement of figures in a plane which displays symmetry across two planes at right angles to one another. Such arrangement may be exhibited diagrammatically, as in Fig. 2. The unit cell may be drawn in various ways, EFKJ, EFLK, RSUT, and so on. The cell contains, however it is drawn, either a whole diamond or enough parts to make up a whole diamond. Each diamond can be divided into four parts: B and D are the reflections of A and C across a plane; C and D are the reflection of A and B across a plane at right angles to the first plane. Unless the diamond, the content of one cell, could be divided in this way there could not be the double symmetry. But, granted this division into four portions, it is not necessary that the four should be arranged as in the figure in order that the double symmetry may be obtained. There are two alternatives (Figs. 3 and 4).

In Fig. 3 the lower half of each diamond—that is to say, the portions C and D—are shifted, whether to right or to left is immaterial, by an amount equal to one half of one side of the cell EFKJ. The symmetry about a vertical line in the plane of the paper is obviously retained. It is not so obvious that there is still any symmetry about the horizontal line until we realize that we mean only "observable symmetry": that which is to be seen in the outer form of the indefinitely extended figure, corresponding to the crystal. Clearly, the whole figure will present the same appearance from below as from above. In fact, we can see that as a whole the lower part of the figure is symmetrical with the upper part by imagining the upper and the lower to be further shifted relatively as in Fig. 3A: the two parts sliding on one another along the line SS. The two parts are then the image of each other across SS in the full sense of the word.

From Fig. 2A we may also realize that the amount of the original shift must be equal to one half of EF: no other shift will give the symmetry which Fig. 3A shows. In Figs. 5 and 5A a different shift has been given, and the failure is clear.

In Fig. 4 not only are C and D shifted parallel to the horizontal line, but also B and D are shifted parallel to the vertical; this time the amount of shift is one half of the side EJ.

The three modes of Figs. 2, 3 and 4 all lead to the same external symmetry. There is one more which is based, as we should say, on a different lattice and is symmetrical, like the others, about two lines at right angles to each other. It is shown in Fig. 6. There are no variations of Fig. 6, as of Fig. 2, to be obtained by the introduction of shifts. If in Fig. 6 we shift C and D relatively to A and B, as we did in Fig. 3A, we find that they can now be described as the direct reflection of A′B′ into CD and of A′C into B′D, and the mode of Fig. 6A is the same as that of Fig. 6.

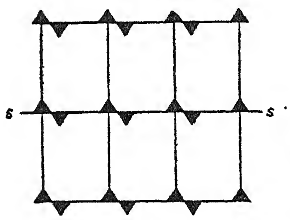

FIG. 5.

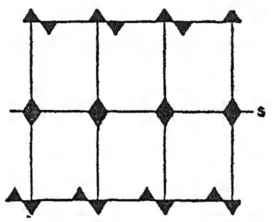

FIG. 5A.

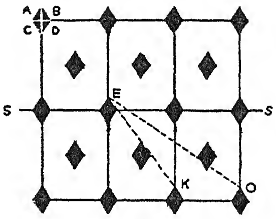

FIG 6.

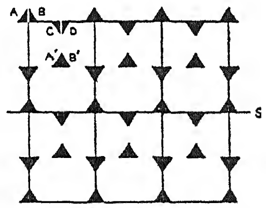

FIG 6A.

There are therefore four *modes* in one *class*: four varieties of internal arrangement which all lead to the same external appearance of symmetry.

Our example is two-dimensional, and the crystal has three dimensions. But there are no new ideas to be added: it is only the numbers of symmetries, modes and classes that are increased. If, for example, we continue the study of the modes of arrangement that lead to an external symmetry of reflection across two planes at right angles to each other, we find that there are four lattices instead of two, and twenty-two modes instead of four. The class containing crystals that possesses this particular form of symmetry is generally called the "hemimorphic class in the orthorhombic system." Its symbol is C_{2v}: the symbols of the four lattices are Γ_0 Γ_0' Γ_0'' Γ_0'''. In every case the content of the unit cell is divisible into four parts, corresponding to the ABCD of Figs. 2 to 6.

The ten modes in the Γ_0 lattice are shown in Fig. 7, which will serve to show the numerical increase due to the introduction of the third dimension. Under each separate figure is given, beside the crystallographic symbol, another symbol which describes the shifts: D^x means a direct reflection across a plane parallel to yz; E^x_y a reflection across a plane parallel to yz, together with a shift parallel to the axis of y equal to half the y edge of the cell, and M^x a reflection across a plane parallel to yz, together with a shift parallel to the diagonal of the yz face and equal to half that diagonal.

Let us now see how the X-ray analysis distinguishes the mode. Let us imagine that Fig. 2 represented a number of pits in a plane reflecting surface. The surface could be used as a grating having many spacings instead of one. If, for example, we so placed it that the horizontal lines of the figure were parallel to the slit of the spectroscope the spacing would be equal to EJ: if the vertical, the spacing would be equal to EF. Again, if the grating were so placed that EK, for example, were vertical, the spacing would be the perpendicular distance between EK and FL. If the surface is pitted as in Fig. 3, the spac-

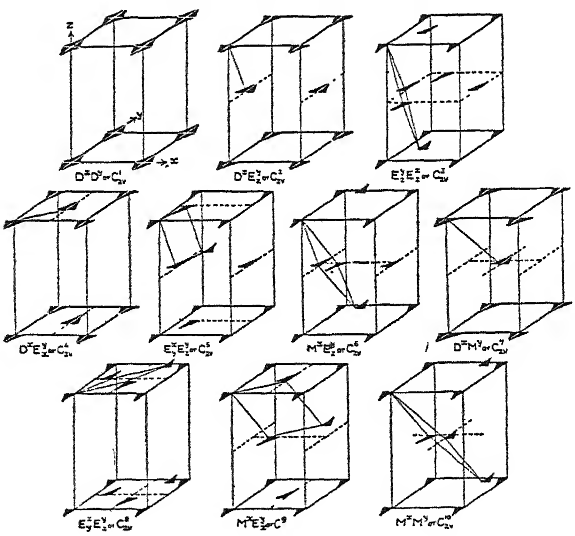

Fig 7

ing when the horizontal line is parallel to the slit is the same as before; but when the vertical is parallel to the slit the effective spacing is only half what it was in Fig. 2. This follows from the fact that if we divided the surface into a number of vertical narrow strips the diffracting effect of each such strip, for this position, depends on the total amount of reflecting surface contained in the strip, but not on its distribution along the slip. It does not matter that C and D are upsidedown as compared to A and B. The strata consisting of C and D portions have interleaved the strata of A and B portions. This halving of a spacing of Fig. 3 as compared with Fig. 2 occurs only when the grating is placed so that the slit is parallel to the vertical line of Fig. 3, and not when any other line is vertical, except by some odd chance connected with the shape of the pits. In this way it is possible to distinguish between Fig. 2 and Fig. 3. The mode shown in Fig. 4 is distinguished by the halvings of both the horizontal and vertical spacings, and of no others. In the case of Fig. 6, as compared with Fig. 1, the spacing is halved when the slit is parallel to the horizontal or the vertical line of the figure, and also whenever the grating is so placed that the parallel to the slit passing through one of the corners of a cell does not pass through the center of that or any other cell, as, for example, if EO but not EK is parallel to the slit. It is therefore easy to distinguish each of the four modes.

Similar methods are applicable to the three-dimensional crystal. If, for example, we consider the case of C^2_{2v} or $D^xE^y_z$ we can show that, whereas in general the spacings of planes are such as are proper to a cell of the dimensions and form drawn in the figure, all planes of the form $lx/a + mz/c =$ an integer, show halved spacings, unless l is odd and m is even: which is sufficient identification of the mode of arrangement. The symbols a and c denote edges of the cell.

If we follow this line of reasoning through all the thirty-two classes, we end, of course, with the discovery of 230 modes which are known to exist: and with the identification marks of each, with certain qualifications. These last are of two kinds. One of them is general in nature and is a consequence of the fact that the X-rays can measure only the distance between two like points in neighboring cells, say A and B. But they do not indicate any differ-

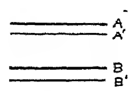

Fig. 8

ence that may exist between AB and BA. If such a difference exists it may be expected to show in the external characteristics of the cell, giving it polarity. A good example is to be found in zinc blende. Layers of zinc and of sulphur atoms alternate with one another as in Fig. 9, all of them being perpendicular to a trigonal axis of the crystal. The distance between a zinc atom in the layer A to a zinc atom in the layer B is found without question by the X-ray method. Now we know from observation of the crystal that there is a difference between AB and BA: the crystal is polar. A crystal plate cut so that its faces are perpendicular to the axis shows different properties on its two sides: if heated, one face becomes positively and one negatively electrified. Whichever face we use in the X-ray spectrometer we

obtain the same value for the spacing, and we find ourselves unable to detect any difference between the two aspects by means of the spectrometer observations.

We may see this point in another way. Suppose that Fig. 9 represents a section of a crystal consisting of two kinds of atoms, indicated respectively by full and empty circles. The arrangement clearly has no symmetry about a vertical line in the plane of the paper. But if X-rays were incident from above, as shown, there would be equal reflections from the planes 11′ and 22′. If the incident rays were heterogeneous and a photographic plate were placed to receive the Laue reflections in the usual way, there would be a symmetry distribution of spots on either side of A, although there is no symmetry in the crystal to correspond.

It is only when we have taken other considerations into account and have determined the structure that we can establish the polarity of the crystal. We may take, for example, the fact that zinc blende is cubic, and therefore has four trigonal axes, a fact which we may discover from X-rays as well as from the external form. Also, the unit cell contains only one molecule of zinc sulphide, and may be drawn of the same form as in diamond: that is to say, its eight corners can consist of the six centers of cube faces and the two ends of a diagonal. If we put zinc atoms at the corners of the unit cell, the sulphur atom must lie either at the center of the unit cell or at the center

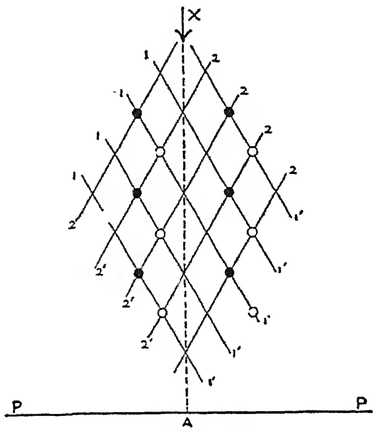

Fig. 9

of the regular tetrahedron formed by four of the corners of the cell: only by the adoption of one of these alternatives do we get the four trigonal axes. The former gives the rock-salt structure and is distinguished by the fact that the (100) and (110) spectra decrease regularly in intensity from lower to higher orders, whereas in the (111) spectrum the even orders are relatively greater than the odd. In the latter alternative the even orders of (100) are relatively greater than the odd, (110) spectra are normal and the second order of the (111) is abnormally small. It is easy to distinguish between the two cases. The latter is adopted by zinc blende. Each atom has the symmetry of Class 31, to which the crystal belongs, there being only one atom of each in the unit cell.

In this case we are successful from X-ray measurements alone in determining the mode of arrangement of the crystal, although the crystal is polar and the X-rays can not detect polarity directly. We have been able to determine the structure completely, and the polarity then appears.

When the determination of structure can not be carried far enough, the X-rays may fail to decide between the presence and absence of polarity. For example, resorcinol is an orthorhombic hemihedral crystal: this is known by its external form. The X-rays show that, this being so, its internal arrangement must be that of M^xM^y or C_{2v}^{10} in Fig. 7. If we had no help from the study of external form, or from any other source, we should not be able to decide between C_{2v}^{10} and the more symmetrical mode known as Q_h^{12} : the symmetry of the latter is obtained by adding a center of symmetry to the elements of symmetry possessed by C_{2v}^{10} : that is to say, by removing the polarity of the crystal. As a matter of fact, the external form of resorcinol clearly shows polarity: or, if we could be sure that the molecule had no symmetry, we could infer that the crystal was unsymmetrical about the xy plane, there being only four molecules in the cell and all these being wanted to give the symmetry observed by X-rays. Thus there are cases where the X-rays can not decide between two modes, one of which can be derived from the other by the addition of a center of symmetry. As, however, the existence of a center of symmetry can generally be decided by other means—for example, by such means as I have described above in the case of zinc blende or of resorcinol—this incapacity of the X-ray method is of no great consequence.

The addition of a center of symmetry moves a structure from one class to another—Class 1 to Class 2, Class 31 to Class 32. Consequently, the X-ray methods are by themselves sometimes in doubt between two modes in different classes when they are rarely in doubt as to the mode within a class. It will readily be understood that the doubt as to class may be of far less importance than the doubt as to mode; though hitherto the former kind of difference has been given all the attention because it has been the only kind that could be observed. A very slight relative movement of the atoms would be sufficient to reduce the symmetry of the crystal from one class to another: but the change from one mode to another

within the same class would mean a complete rearrangement of the molecules.

There are two cases in which the X-rays can not distinguish between two modes in the same class. These are Q^8 and Q^9 in the enantiomorphous class of the orthorhombic system, and T^3 and T^5 in the tetartohedral class of the cubic system. The ambiguity disappears, however, if there are only two molecules in the unit cell, when the former alternative is alone permissible in each case: it would disappear also in any case in which the structure could be determined completely by any other means.

It has been known for many years, thanks to the work of Fedorow, Schonflies and Barlow, that the 230 modes of arrangement represent all the possible forms of internal crystal structure. In each mode of arrangement there is a relative disposition of planes, axes and center of symmetry, which is characteristic of the mode, and the mode may be described in terms of these symmetries. This was the language used in the original work on the subject, and the term space group was used, instead of the term mode of arrangement, in reference to the particular group of symmetry planes, axes and center in space. When the subject is approached from the point of view of the X-ray worker, the language of the mode of arrangement has its special conveniences. A list of the 230 modes and of the X-ray tests for each mode has recently been published in the Transactions of the Royal Society by Astbury and Yardley. Lists of the same 230 space groups have already been published in different terms by writers on crystallography: recently a list by Wyckoff has been published by the Carnegie Institution of Washington, in which each space group is expressed in terms of the coordinates of the arrangement of points required to give each space group its special characteristics.

It may be of interest to look at these matters from a somewhat different point of view, which takes in the question of the permanence of the chemist's molecule when built into the solid structure.

In every crystal the unit can be divided into a certain number of parts, each of which has no symmetry of its own, but may be made to coincide with any other part by some combination of reflections, rotations and shifts. The number is always either one, two, three, four, six, eight, twelve, twenty-four or forty-eight. The division into 230 modes of arrangement refers to the arrangements of these parts. In the case of a crystal of the rock-salt type both the positive and negative portions of the cell can be so divided. Very often the part in question is the chemical molecule. For example, the cell of the monoclinic prismatic class can be divided into four such parts. The X-ray measurements show that the unit cell of benzoic acid which belongs to this class contains four molecules. Also they detect the existence of the four parts, and determine the mode of their arrangement. It is natural to make the assumption that each part is a molecule. This, it may be noted, involves the existence of right- and left-handed molecules, as built into the crystal.

Sometimes the division into parts involves the division of the molecule. The molecule then consists of two or three or more parts, and therefore possesses a corresponding symmetry. For example, the naphthalene molecule in the naphthalene crystal contains two parts, and has a center of symmetry. The molecule of FeS_2 in the crystal of iron pyrites consists of six parts, and has a center of symmetry and a trigonal axis. Each of the two atoms in the rock-salt cell, sodium and chlorine, has—that is to say, its relations to its neighbors have—forty-eight parts, and therefore the full symmetry of the crystal.

Much more rarely a part consists of more than one chemical molecule. So far a few instances have been met with. The "part" in the crystal cell of sulphur certainly contains two, perhaps more, atoms. Miss Yardley finds that the "part" in the fumaric acid crystal contains three, perhaps six, of the molecules as ordinarily defined $(COOH.CH:)_2$. In the cell of α-naphthylamin at least three molecules go to a part. The part has no symmetry, so that the molecules that compose it differ from each other in some way. These are really examples of polymerization in the crystal.

Is the grouping of the atoms in the molecule as displayed in chemical reactions maintained without change? When the first results of the new methods were published, with their determinations of diamond and rock-salt structure, there was some unnecessary alarm as to the apparent disappearance of the molecule. If there had been anything to suggest a complete disruption of all the alliances in the molecule, which had been so long and so successfully studied by the chemists, the alarm would have been justified. Atomic bonds would have been annoyingly variable and dependent on conditions, and we should have been put back to the starting point in the investigation of the solid. This condition of things appears, fortunately, to have no existence. The conclusions of chemistry are carried into the solid, with only such modifications as might reasonably be expected. Our new science is in full and close alliance with chemical science already established: it is in fact a constant and delightful experience to find some direct confirmation or illustration of an inference already drawn from other sources. So far as experience has to tell us, the chemical molecule generally takes its place as such in the crystal structure with little change.

To sum up, we are now able to replace the rough

division into thirty-two by the finer division into 230. This is advancing a whole stage towards the final solution of the structure problem. We carry the analysis right up to the limits which can be foreseen by the mathematical investigation of the geometry of space. We require only a sufficient number of X-ray measurements: if these can be obtained, the crystal then—with certain additional information as to polarity—can be assigned to its particular mode or space group, with one or two exceptions as already noted. It may be that the structure of the crystal is so simple that having got so far the full solution is already in sight. In the vast majority of cases this is not so; we have only come to the end of the second stage of the work.

The first stage was complete when we had found the dimensions of the crystal unit cell: the second is completed when we know which of the 230 possible arrangements of molecules, or, in other words, space groups, the crystal structure follows.

If the structure of the crystal is not yet obvious—and in the great majority of cases this is far from being the case—we enter on a third stage, in which the mode of procedure is less stereotyped and more difficult, perhaps all the more interesting. We have now to find, if we can, the arrangement of the atoms within the cell, to which task the knowledge already gained is an indispensable though, it may be, a quite insufficient contribution.

As I have said already, the X-rays do not tell us directly the relative positions of the atoms within the unit cell. They have, however, much to tell us as to the relative intensities of the different orders of reflection by each plane, and these must depend on the atomic arrangements. It is to be admitted, however, that we are as yet unskilled in the interpretation of this evidence. We do not completely understand how varying conditions affect intensities of reflection, though we have learned a great deal through the work of W. L. Bragg, Darwin, Compton and others. And, of course, when the cell contains many molecules, their positions being as yet unknown and their separate contributions to the intensities in any case doubtful, the observations of intensity are very difficult to make use of, though they can be accurately measured. We can only avail ourselves of such bold indications as that a very strong reflection implies the location of many atom centers on or near the plane in question, particularly if there are higher orders: or we may find ourselves able to show that an especially strong second or third or other order implies the adoption of some particular alternative arrangement. A very interesting example of a general influence of form upon intensity is to be found in the reflections from the fatty acid layers which have been investigated by Muller and Shearer. The first, third and other odd orders are much more intense than the second, fourth and other even orders. A simple explanation is found in the fact that these long chains face opposite ways alternately, and that the number of scattering centers is distributed fairly evenly along their length. At the ends, however, the uniformity of distribution is interrupted; at one end, probably the carboxyl end, there is an excess per unit length; at the other, the methyl end, a deficiency. Thus we may say that the effect on an odd order of the spectrum due to a single layer, the thickness of a layer being twice the length of a molecule, contains a factor:

$$A \sin(\omega t - \alpha) - B \sin(\omega t - \alpha - \overline{2n+1\pi}) = (A + B) \sin(\omega t - \alpha).$$

The factor for an even order is:

$$(A - B) \sin(\omega t - \alpha).$$

If at both ends there had been an excess of scattering centers, we should have found the even orders stronger than the odd: the effect we find, for example, in the (111) planes of rock-salt. In the case of the simpler inorganic crystals like rock-salt, diamond and so on, intensity observations are conclusive as to the structure: in the case of iron pyrites or calcite they are very nearly so. But in the case of quartz, where the cell contains nine atoms, still more in the case of an organic compound, they do not carry us very far. We hope that greater experience will give us in the future the power of using them to better advantage.

In what other direction then shall we look for additional means of approaching more nearly to the final solution of the problem of structure?

The answer to this question will take account of all the store of physical and chemical knowledge which we already possess. Having solved, wholly or in great part, the structure of some of the simpler crystals, and being able to proceed in all cases, even of the most complicated crystals, to the determination of the number of molecules in the cell, and of their mode of arrangement, we must try to correlate what we have found with the properties of the crystal. By that means we shall become gradually more certain of the general connection between the structure and its physical and chemical properties; we shall become able to settle further structural details in various cases, and so, by alternate and mutually supporting advances, we may hope to reach our goal.

Let us consider what is being done in this direction. First of all there is the question of the distribution of the atoms in space. Given so many atoms, to be packed into a cell of known dimensions, what information have we as to the space that each must occupy? The answer to the question can not be simple, because we may not expect that the atoms are always to be treated as spheres, still less as

spheres of constant radius. It is as generally difficult to state the distance between one atom and another as to state the distance between a table and a chair. Nevertheless, the atom-radius is a useful conception, especially when its dependence on the nature of combination is taken into account. The question has been considered by W. L. Bragg, Wyckoff, Davey and others, and it appears that an atom does make a definite contribution to the distance between its center—when it can be assumed to have a center—and the center of a neighbor, so long as the nature of the bond remains the same. This is a valuable contribution to the study of structure. It is proved by the examination of simple structures like those of the alkaline halides, and we may assume its reliability in our attempt on more complicated problems. And, of course, it is interesting from the point of view of atomic structure itself and atomic linkages.

The radius seems to depend on the tightness of the bond as in bismuth or in graphite, where there are two kinds of bonding, and the plane of cleavage cuts across all the longer distances from center to center. In calcium fluoride the centers of calcium atoms are closer together than they are in the metal itself in spite of the interposition of the fluorine atoms; and in calcium oxide they are still closer. The change in the type of the bonding has altered the value of the radius.

There is also the very interesting but still more unsettled question of the mutual orientation of the bonds between an atom and its neighbors. It is, of course, the carbon atom which is the occasion of this problem in its most pressing form. In the diamond the exactly tetrahedral arrangements of bonds is associated with great rigidity, which implies great stiffness of orientation. The analysis of the structure of graphite has lately been carried by Bernal to a stage very near completion, but the only point in any doubt is unfortunately the very one as to which certainty would be welcome. Has the great weakening of one bond interfered with the relative orientation of the other three? Debye thought that the structure was trigonal, and that the atoms were arranged in layers which were like the layers of diamond, except that they were flattened out without a sideways extension of the network. This would involve a closer approach of carbon atom centers from 1·54 A. U. to 1·45 A. U.; against which no obvious objection can be offered, but it would be interesting to know how it happened. Hull believed the structure to be hexagonal, and that the layers remained as in the diamond. Bernal, having found some good graphite crystals to which the single crystal methods could be applied, finds that Hull is correct as to the hexagonal structure, but inclines to the belief that the layer is flattened. In the latter case, we must suppose that the carbon atom has three very strong bonds almost coplanar with the carbon and one weak bond at right angles to this plane.

The question arises in another form in the investigations of the long carbon chains by Piper and others, and especially by Muller and Shearer. If the chains are formed by the linking of carbon atoms together in such a way that the junctions of one atom to its two carbon neighbors are inclined to one another at the tetrahedral angle of 109°28′, as in diamond, then there are three possible forms of chain. In one of them, each two carbon atoms imply an increase of 2.00 A. U. in the length of the chain, and, in a second, an increase of 2.44 A. U. In these two cases the carbon atoms of a chain can lie in a plane. With one exception, all the cases examined show one or other of these two rates of increase. The third form of chain is a spiral, for which the growth of each single atom added is 1.12. In one case this rate of increase is found to hold: it is that in which the chain contains a benzene ring. This agreement between calculation and experiment shows with some force that the relative orientation of the bonds is maintained. Even when two or four hydrogens are stripped from the chain at various points, so as to leave a double or triple bond between consecutive carbon atoms, to adopt the ordinary chemical language and theory, no measurable change is found in the length of the chain. This does not mean that there is no change in the distance between neighbors: such a change would be small and might escape detection. But it does mean that there is no great change in the general straightness of the chain, such as might be expected from any large change in the mutual orientation of the bonds between the carbon atom and its neighbors.

In calcite the three oxygens which surround a carbon atom must lie in one plane. It is supposed, however, that in this case the bonds are electrostatic: the carbon atom has lost its four valency electrons, and with them its powers of tetrahedral orientation.

Now if we can discover the extent to which an orientation is maintained under different conditions we are provided with one more guiding principle in our attempt to discover the structure of the crystal which contains carbon atoms. And, of course, the organic compounds center round the carbon atom and its tetrahedral structure.

The question of orientation in respect to other atoms is more obscure, but it is clearly one of importance. There must be some reason why ice has such an open structure, and here the oxygen atom is largely concerned. In the ruby the oxygen atom has no plane of symmetry in relation to its neighbors. In organic substances the great emptiness of the structure implies that atoms are attached to one

another at points which have definite positions on the surfaces of the atoms and are limited in number. And, generally speaking, the consideration of organic crystal structure is against any idea that atoms and molecules are to be treated as spheres surrounded by uniform fields of electric force, except in certain cases where by loss or gain of electrons an atom has been reduced to the outer form of one of the rare gases. They must have highly irregular fields, having forms which more or less resist any change. The weak bonds which hold molecule to molecule in the organic substance are not due to electron sharing as in diamond, or to ionization as in rock-salt, but to an intermingling of stray fields belonging to definite positions on the surfaces of the molecules.

Our attempt to discover the effect of orientation is part of a general attempt to discover the field of force of the atom, which is naturally a very difficult matter. But if we can learn only a few rules, even empirical rules, we are so much the further on our way.

Yet another obvious and most important source from which help may be obtained is to be found in chemistry itself. Although the chemist has had no means until now of measuring distances and angles, he has been able to build up a wonderful edifice of position chemistry. An atom A of a molecule is certainly linked, it may be to B, and not to C; or again, of a number of atoms of the same nature and contained in the same molecule, so many must be alike, and so many may be different.

The chemist has, for example, come to the conclusion that the naphthalene molecule is a double benzene ring, and the anthracene a triple benzene ring. The X-ray observations show that one of the sides of the unit cell of the latter crystal is longer by 2·5 A. U. than the corresponding side of the other, all other dimensions of the two cells being very nearly the same. The width of the hexagonal ring in the diamond is 2·5 A. U., so that on the one hand the chemical evidence suggests that the length of the molecule is parallel to that edge of the two cells which shows differing values, and on the other the X-ray conclusions give material support to the chemical view. Let us take another example from basic beryllium acetate $Be_4O(C_2H_3O_2)_6$. The substance is remarkable for the ease with which it sublimes into a vapor consisting of whole molecules, from which we may infer that the molecule does not suffer much change in the process. The relative positions and mutual alliances of the atoms are nearly the same when the molecule is free as when it is built into the solid. From the X-ray evidence we learn that the molecule has four intersecting trigonal axes. We must place the unique oxygen at the center of a regular tetrahedron, and the four beryllium atoms at its corners. Each of the six acetate groups must be associated with one of the tetrahedron edges, and in such a way that the four trigonal axes are maintained. This necessitates, as crystallographic theory shows, the existence of a dyad axis through the middle points of each pair of opposite edges of the tetrahedron. The $C_2H_3O_2$ groups must be added so as not to interfere with the existence of these axes. If they are placed correctly for the trigonal axes, each of them has a dyad axis of the kind mentioned. All this agrees with the chemical evidence as partly stated in the formula, which implies:

(1) That there is one oxygen differently situated to the rest.

(2) That the four beryllium atoms are all alike.

(3) That the acetate groups are all alike.

Further, chemists would say that the carbon atoms are not alike; in that case, they must both lie on the dyad axis, since if they did not they would necessarily be symmetrically placed with respect to that axis and would be equivalent. On the other hand, the oxygen atoms in the acetate group can not lie on the axis if, as is probable, they are equivalent to one another. They must be placed symmetrically with respect to the dyad axis. As to the hydrogens, we must assume either that they do not count, which is not at all unlikely, or that they are not all alike. It is impossible to place eighteen hydrogen atoms so that the group has four intersecting trigonal axes and that every hydrogen is like every other. The molecule has no plane of symmetry, the fault lying with the oxygens. It could not be due to the hydrogens because there are marked differences in the intensities of reflection of pairs of planes, which differences would not exist if there were planes of symmetry, and would be small if due to dissymmetry in the positions of hydrogens only. It is by reasoning along such lines as these that X-ray evidence and chemical evidence can help each other. Many other instances might be given; indeed, no complex crystal can be studied with success without calling in the assistance of chemical arguments.

A fourth example of the connection between arrangement and properties is to be found in the recent work by W. L. Bragg on the indices of refraction of crystals. It has been found possible to calculate the indices of refraction of calcite, given the dielectric capacities of calcium, carbon and oxygen atoms separately. The difference between the two principal refraction indices is almost entirely due to a difference between the dielectric capacities of a set of three oxygen atoms, at equal distances from one another, when placed:

(1) So that the plane in which they lie contains the direction of the field.

(2) So that this plane is perpendicular to the field.

If we are able to calculate the refractive indices on these data, then it must be possible to find conditions governing the arrangement of the atoms, when we know the composition of the crystal and its refractive indices. For instance, the near equality of the refractive indices of potassium sulphate implies that the dielectric capacity of the SO_4 group is much the same in all directions, and this is in agreement with the hypothesis that the oxygen atoms are grouped in some sort of tetrahedral fashion about the sulphur atom.

There are still other connections between structure and properties which we begin to understand, and can use in proportion to our understanding. The cleavage plane, and the occurrence of certain faces in preference to others are connected with the nature of the bonds and the size of the spacings. We are not surprised to find that in bismuth or graphite or naphthalene the cleavage plane cuts across the ties which we should expect to be the weakest of those that bind the molecules together; or again, that natural faces follow the planes that are richest in atoms or molecules and may be assumed to contain relatively large numbers of linkages. In naphthalene the cleavage plane passes between the ends of the molecules, where the β hydrogens are, and where there is a deficiency in the number of scattering centers, as the X-rays indicate by the strengths of several orders of the (001) reflection. The other faces found on the crystal cut across the ties at the positions of the α hydrogens.

There are many other connections between the structure and other properties of a substance, such as dielectric capacity, rigidity and compressibility, conductivity both thermal and electric, magnetic constants. In fact, the only properties of solid bodies which are not directly and obviously related to crystal structure are those, few in number, that depend on atomic characteristics alone, such as weight; and the absorption coefficients for α, β, γ and X rays, all the rays which involve high quantum energies. With few exceptions every aspect of the behavior of a solid substance depends on the mode of arrangement of its atoms and molecules. We have, therefore, an immense field of research before us, into which the X-ray methods have provided an unexpected and welcome entrance.

They tell us directly, as I have said, the number of molecules in the crystal unit cell, and the mode of their arrangement with such determination of lengths and angles as are required to define the mode of arrangement in full. They leave us then to ally our new knowledge to all that we possess already as to the physical and chemical properties of substances. By this comparison we hope in the end to determine the position of every atom, and explain its influence through its nature and position upon the properties of the substance. It is the chemistry of the solid that comes into view, richer in its variety even than the chemistry we have studied for the past century, and possessing an importance which is obvious to us all. Every side of scientific activity takes part in this advance, for all sciences are concerned with the behavior of matter.

W. H. Bragg

REMINISCENCES OF LORD KELVIN

On the hundredth anniversary of the birth of Lord Kelvin, celebrated by the scientific world, it may be permitted for the writer to record personal experiences of his kindness and impressions of his interesting personality.

When in England among the scientists in the late eighties of the last century, it was most gratifying to receive from Lord Rayleigh a letter of introduction to Sir William Thomson. When Lord Rayleigh came to America to attend a meeting of the British Association in Canada, he visited the laboratories of Wellesley College and was graciously disposed to put in the way of the first woman undertaking a department of physics in a college access to the best in her subject in England.

Though it was summer and vacation in the University of Glasgow, there was received from Lady Thomson a cordial letter, stating that she and Sir William were to come up from their country place in Ayrshire to assist in doing the honors in the university for the British Medical Association, then in session. She enclosed a card of invitation to the reception to be given to the medical men and asked me to come at nine o'clock to go with them.

At the appointed hour I was welcomed by our host, a man of quiet, almost quaint appearance and manner, but shining from his kind eyes a winning friendliness. Lady Thomson, in garnet velvet, tall and handsome, quite resplendent with pearls and diamonds, stood beside him. The reception was in the stately Gothic senate chamber, lately given to the university by the Marquis of Bute. All the faculty in academic dress and the ladies were gathered on the daïs.

After being presented to Principal Caird and others, from a point of vantage amid the brilliant group, one saw all Glasgow, much of Edinburgh and the British doctors file past.

It was evident that Lady Thomson was the acknowledged social leader, and that Sir William was the one whom all the guests were most eager to meet.

The next day several memorable hours were spent

in the laboratories, where much was going on. Half a dozen alert young students, some of whom have since become distinguished, were at work; here they were hands and feet under the control of the master mind, trying one device and then another to overcome difficulties in the performance of instruments later perfected. I sat by and watched how the mind of the original investigator works. His luminous face was an interesting study. Later he explained the evolution of his quadrant electrometer and siphon recorder, showed early models of cable devices and told dramatic experiences on his three Atlantic cable-laying voyages.

He told of Maxwell's great works—said he had not mastered all his equations yet—"I took a pull at them after returning from the reception the night before" he added. Lady Thomson showed the notebooks he always kept about to catch new ideas or develop old ones; sometimes these were called to service in the night, which reminds one of Emerson, who used to wake up his wife because he had a thought. Sir William took me to his lecture room; showed his shoemaker's-wax experiment, in which the lead bullets from above and the wooden cubes from below were working their way through, as he conceived the earth ploughs through the ether. He showed his "secular experiment," as he called it, which he said was to go on for a hundred years to show the rate of travel of molecules. One wonders if that long tube is still on the wall of the Glasgow laboratory.

Going to the house for tea, the African parrot was introduced—"Dr. Red-tail, alias Parnell or Donnelly, because he is an obstructionist, and if he can not have his way makes it impossible for others to have theirs."

Sir William talked of Scotch history, of Prince Charlie and Jacobite music, of Highland legends, of American politics.

In contrast to many other English and German scientists, Sir William seemed neither surprised nor alarmed that a woman should devote herself to mathematics and physics. This was thirty-five years ago.

Some months later the meeting of the British Association of Science was at Bath. It was an epochal meeting, for the work of Hertz, showing the identity of light and electricity, thus verifying the prediction of Maxwell, was just being discussed and "Section A" was full of excitement. The American stranger was taken under the kind care of Lady Thomson, who was always at her husband's elbow, correcting his proof or amending his absent-mindedness, saying, "Sir William, here is so and so, you must meet him."

Through their kindness a dinner at the beautiful home of their host, a nephew of John Bright, was enjoyed. It was worth while to listen to the brilliant conversation between Sir William and Jannsen, the distinguished French astronomer, Oliver Lodge, Glazebrook and other like guests.

After ten years it was again my good fortune to be at another notable meeting of the British Association at Liverpool. The x-rays had just been discovered, and Lenard, who did the pioneer work, was a guest of honor. It was here a sidelight on the personality of Lord Kelvin, for he had now been elevated to the peerage, to see how all the Englishmen of science not only revered but loved him.

To hear the veterans, Kelvin and Stokes, in high debate with other giants of science as to the "particular go" of the half dozen new kinds of radiation lately discovered was something to remember.

Lord Kelvin asked me to a private séance with Lenard and his tubes. His child-like ingenuousness was delightful. While every one was hanging on his words, his attitude was always that of the questioner and learner.

This was deeply impressed in the final experience I had with Lord Kelvin. He was to lecture in Faraday's Theater in the Royal Institution in London. Professor Dewar sent tickets and an invitation to a reception given at his house after the lecture. It had became a rare thing for Lord Kelvin to lecture, and a notable audience was gathered from all the universities to honor the occasion. Every one was in full dress, as is the wont at these famous Friday evening lectures. The semi-circle of men fronting the lecturer was remarkable, every man of international reputation—Lord Rayleigh, who discovered argon, Ramsay, of helium fame, Crookes, of the cathode rays, Huggins, "father of the new astronomy," and a score of others almost as noted. Lord Kelvin spoke slowly, with singular unconsciousness of his audience. He seemed to be rather thinking aloud and watching his experiment with intent look and uplifted finger, looking for the result as if to learn something new himself.

Lord Kelvin was great enough to lead the mathematical physicists of his day and kind enough to give the inspiration of his talk, and answer patiently the questions of eager young students.

SARAH FRANCES WHITING

SCIENTIFIC EVENTS

THOMAS CORWIN MENDENHALL

A MEMORIAL to Dr. Thomas Corwin Mendenhall, prepared by the committee on necrology, was presented at the meeting of the Ohio Academy of Science at Columbus on April 19, by Professor Herbert Osborn. The memorial reviews Dr. Mendenhall's life and services to science, which were the subject of a special article by Mr. G. R. Putnam

printed in the issue of SCIENCE for July 11, 1924. The concluding part of the memorial of the Ohio Academy is as follows:

Dr. Mendenhall's active connection with our Ohio Academy of Science began shortly after his return to Ohio in 1912 and he has been a devoted and helpful member interested in promoting its every interest. Almost as soon as he had acquired membership he was elected president, a quite unusual proceeding. This occurred at Oberlin meeting, 1913, and he served for the year 1914 with such skill and enthusiasm as to give us all renewed courage and confidence in the mission of the academy.

As trustee and for a number of years chairman of the research fund of the academy, serving from 1916 to his death, he was greatly interested in the use of the academy funds for research and used rare discrimination in the assignment of its limited income to secure the largest benefits in the encouragement of research.

He was particularly interested in the securing of larger support for the academy, and served most faithfully on the legislative committee which sought state support for the academy activities, especially for publication of the results of scientific studies. He expressed the hope, and it was one of his cherished projects, that the academy might be provided with a suitable building for its permanent home and as a center of its activities and that it might serve in some very vital way for the promotion of the scientific functions of the state. His recommendations and suggestions are matters of recent record and may serve us in our future efforts for the development of scientific activities in the state.

With all these relations the thing we feel most deeply to-day is the friendly nature of his work among us. With the most unusual experience in scientific development of more than half a century, a remarkable acquaintance with scientific work and workers he possessed such a broad appreciation of the work and accomplishments of others and such a friendly attitude toward even the most humble worker in the field of science that his presence and interest were a constant source of encouragement. With a multitude of honors and distinctions he was still one of the most democratic and unassuming of men. With a wealth of achievement, seldom equalled, to his credit he was ever modest in reference to the importance of his own contributions to science. He was a man whom we could admire and love, whose friendly greetings will be missed but whose memory will be cherished as representing the finest spirit of scientific devotion, achievement and fellowship. We have recorded our esteem and appreciation of his worth in such honors as it was in our power to give. We have now to place on record, as our lasting recognition, this declaration of our high regard for his service, our great indebtedness for his many activities in the academy and our tribute to his memory as a friend and fellow worker. His fine accomplishments and inspiring personality will long remain with us as a beautiful memory.

HERBERT OSBORN, *Chairman,*
A. D. COLE,
WM. MCPHERSON

MINNESOTA EXPEDITION TO THE HAWAIIAN ISLANDS

THERE has been organized at the University of Minnesota an expedition to the Hawaiian Islands to make a survey of the marine fauna and flora along the coast, with special reference to the algae and the food of fish. Members of the expedition include: Dr. Josephine Tilden, professor of botany; Dr. W. A. Riley, chief divisions of entomology and economic zoology; Dr. Henry A. Erikson, chairman, department of physics; Dr. R. A. Gortner, professor of plant physiology; Dr. J. Arthur Harris, professor of botany; Dr. Shirley P. Miller, instructor of anatomy, and Dr. Royal N. Chapman and Dr. William E. Hoffman, of the department of zoology.

The occasion of the trip is the First Pan-Pacific Food Conservation Conference. Members of the Minnesota group are among the delegates representing the United States. Following the termination of the conference the group will remain for the rest of the summer in the Hawaiian Islands where they will begin their research investigations which are closely related to the purposes of the conferences. This work will be a cooperative study of the plants and animals inhabiting the waters bordering on the islands with especial emphasis upon their relations to the production of human food.

THE PRIZE ESSAY AWARDS OF THE AMERICAN CHEMICAL SOCIETY

ACCORDING to *Industrial and Engineering Chemistry*, Secretary of Commerce Herbert Hoover, chairman of the National Awards of the American Chemical Society, has announced that six four-year scholarships to Yale University, consisting of tuition fees and $500 a year in cash, have been awarded to the following students:

DONALD VIVIAN, Phoenix, Ariz., "The relation of chemistry to health and disease."

JAMES C. REID, Dallas, Texas, "The relation of chemistry to the enrichment of life."

OLIVER C. PITTMAN, Commerce, Ga., "The relation of chemistry to agriculture and forestry."

ELTON R. ALLISON, Centralia, Wash., "The relation of chemistry to national defense."

BENJAMIN NASSAU, Hartford, Conn., "The relation of chemistry to the home."

EUGENE R. BROWNSCOMBE, Santa Rosa, Calif., "The relation of chemistry to the industries and resources of California."

Over 500,000 students all over the United States competed, and six prizes of $20 in gold and certificates of honorable mention have been awarded in each state and in the District of Columbia. The state winners entered the national contest, and it is from their essays that the six winners were selected.

The contest will be continued next year, and in addition to the prizes offered to students of high and secondary schools, which will be substantially the same as those awarded this year, six prizes of $1,000 each will be awarded to students of colleges and universities for the six best essays on the subjects designated:

"The relation of chemistry to health and disease."
"The relation of chemistry to the enrichment of life."
"The relation of chemistry to agriculture or forestry."
"The relation of chemistry to national defense."
"The relation of chemistry to the home."
"The relation of chemistry to the development of an industry or a resource of the United States."

Universities granting scholarships in addition to those provided by Mr. and Mrs. Garvan are the University of Arizona, which gives two scholarships remitting all fees; the University of Iowa, one scholarship; the University of Kentucky and the University of Mississippi, each one. In South Dakota the Northern Normal and Industrial School at Aberdeen offers a prize of $25 for the best essay submitted in the state. In Texas the Baylor College for Women offers a scholarship worth $120, and the University of Texas offers a tuition scholarship worth $120. The University of Utah has contributed a tuition scholarship, and Washington and Lee University in Virginia is offering a tuition scholarship worth $80. Both the Catholic University of America and Georgetown University will grant four-year tuition scholarships, while the University of Virginia offers a four-year scholarship to the author of the best essay submitted in that state. The University of Florida will award two one-year scholarships remitting registration and laboratory fees; Northwestern University offers one scholarship; the University of Maryland offers a tuition scholarship; St. Louis University, a four-year scholarship, including matriculation fee; and the University of Missouri has established six fellowships for the six prize-winning essays in Missouri.

PSYCHOLOGICAL RESEARCH AT YALE UNIVERSITY

An important development of the research work in psychology at Yale, the appointment of three men of national distinction, and the gift of funds to carry on the new work are for the first time definitely announced by Yale University.

A group of research specialists will be associated together in an institute devoted to the study of fundamental problems of human behavior, and to the training of personnel for the further pursuit of new studies in the field of teaching, research and of practical application. The initiation of this enterprise is a step of the first importance toward increasing the facilities for psychological research and training. The need of such research has been increasingly felt in medicine, in industry, in education, in social work, in child welfare and in various public problems. A generous contribution for a period of five years toward this undertaking has been made by the Laura Spelman Rockefeller Memorial.

Roswell Parker Angier, professor of psychology in Yale University, will act as chairman of the group or institute, which will be an integral part of the university. It will be closely associated with the graduate school; its facilities will be available to advanced students who may be candidates for a doctorate or who may wish to engage independently in research.

Arrangements have been concluded for bringing to the institute three leading men of science. Robert M. Yerkes, formerly of the National Research Council, will have charge of the work in the field of comparative psychology with special reference to the primates; Raymond Dodge, formerly professor of psychology in Wesleyan University, in fundamental aspects of normal behavior, and Clark Wissler, of the American Museum of Natural History, in the fields of racial, and particularly primitive, human behavior in its cultural and social aspects.

SCIENTIFIC NOTES AND NEWS

At the meeting of the British Association for the Advancement of Science, held in Toronto from August 6 to 13, general lectures were delivered as follows:

Evening discourses.

Sir Thomas Holland on "Formation and destruction of mineral deposits."

Professor D'Arcy W. Thompson, of St. Andrews University, on "The shell of a nautilus."

Citizens' lectures.

Professor A. S. Eddington, of the University of Cambridge, on "Einstein's theory of relativity."

Professor G. H. F. Nuttall, of the University of Cambridge, on "Cambridge."

Sir Robert Robertson, of the Royal Arsenal, Woolwich, on "Explosives."

Lectures to children.

Sir William Bragg, of the University of London, on "Crystals."

L. H. Dudley Buxton on "The people who live beyond the great wall of China."

Professor J. H. Priestly, of the University of Leeds, on "Plant waterproofs."

The annual meeting of the French Association for the Advancement of Science was held in Liége from July 28 to August 2, under the presidency of Professor M. Viala. This is the first time that the asso-

ciation has met outside France. The King of Belgium presided at the opening meeting, when the medal of the association was conferred upon M. Poincaré and Cardinal Mercier.

Dr. Waro Nakahara, of the Rockefeller Institute for Medical Research, has been awarded the degree of doctor of medical science by the Imperial University of Kyoto, Japan, in recognition of his work on cancer immunity.

The Royal College of Surgeons of England has awarded its Lister Medal for distinguished contributions to surgical science, with the honorarium of £500, to Sir W. Watson Cheyne, who, in accordance with the conditions of the trust, has undertaken to give an address at the Royal College of Surgeons next year.

The Cagnola prize (gold medal and 2,500 lire) has been awarded by the Lombardy Academy of Sciences to Dr. E. Greppi, of Milan, for his studies on hemoglobin.

The Leibniz Silver Medal, for 1924, of the Prussian Academy of Sciences has been awarded to Fraulein Lisa Meitner, professor of physics at the Kaiser Wilhelm Institute in Dahlem, near Berlin, in recognition of her researches on radium.

For the year 1924 the American Geographical Society of New York has awarded its three gold medals as follows: The Cullum Geographical Medal to Professor Jovan Cvijić, of Belgrad University, for his contributions to Balkan geography; the Charles P. Daly Medal to Colonel Claude H. Birdseye, who descended the Grand Canyon of the Colorado in the summer of 1923, in charge of a party studying the water-power possibilities of the canyon; the David Livingston Centenary Medal to Commander Frank Wild, well known for his Antarctic work.

Medals of the Royal Geographical Society have been awarded as follows: The Founder's Medal to Ahmed Hassanein Bey for his journey in 1923 to Kufra and Darfur; the Patron's Medal to Commander Frank Wild for his long services to Antarctic Exploration. The council have awarded the Victoria Medal to J. F. Hayford, formerly of the United States Coast and Geodetic Survey and now director of the College of Engineering of Northwestern University, for his establishment of the theory of Isostasy; the Murchison Grant to J. H. Reynolds for his work on the 1/Million Map and for the Permanent Committee on Geographical Names; the Back Grant to M. C. Lester for his geographical work in Graham Land; the Cuthbert Peek Grant to F. Kingdon Ward to assist him in his present journey in Tibet; the Gill Memorial to Major A. L. Holt for his surveys in Arabia.

At the annual general meeting of the Faraday Society, held on July 7, in London, Professor F. G. Donnen was elected to succeed Sir Robert Robertson as president.

Professor Michael I. Pupin and Dean George B. Pegram, of the Schools of Mines, Engineering and Chemistry, have been designated to represent Columbia University at the centenary of the Franklin Institute, Philadelphia, September 17 to 19.

Professor Vladimir Karapetoff, of the school of electrical engineering at Cornell University, has been nominated on the Socialists' New York State ticket for the office of state engineer and surveyor. Two years ago the late Dr. Steinmetz was the socialist party's nominee for the same office.

D. B. Dow, of the Petroleum Experiment Station of the Bureau of Mines, has been appointed engineer in charge at the new station now being established at the University of Wyoming.

Henry C. Berger has resigned from the research staff of the U. S. Bureau of Mines to take the position of research chemist for the Armstrong Cork and Insulation Company, New Jersey.

Dr. R. E. M. Wheeler has been appointed director of the National Museum of Wales, in succession to Dr. William Evans Hoyle, who resigned the position recently owing to ill health.

Dr. C. V. Piper, of the United States Department of Agriculture, who has been studying pastures and meadows in Europe, returned in the latter part of July.

The orator at the University of Chicago, at the convocation on August 20, will be Professor John Merle Coulter, head of the department of botany at the university, whose subject is "The international mission of universities."

A bust of the late Professor Blanchard, the parasitologist and authority on tropical medicine, has recently been unveiled at his birthplace, Saint-Christophe, in Touraine.

The Société d'Anthropologie of Paris recently celebrated the centenary of the birth of Paule Broca, who founded the society in 1859.

The death is announced of Dr. David Lobo, emeritus professor of obstetrics and rector of the Central University of Venezuela, recently president of the National Academy of Medicine.

Dr. Filip Počta, professor of paleontology and geology at the University of Prague, died recently at the age of sixty-five years.

The death is also announced of M. Emile Pierard,

of Brussels, president of the Société Belge des Electriciens, and an authority on the subject of electric transmission lines.

THE Commission on Standardization of Biological Stains is at work preparing a book on stains, dealing with their chemistry, synonymy and uses, discussing the characteristics of satisfactory and unsatisfactory stains. At present the chairman of the commission, H. J. Conn, is on leave of absence from the New York Agricultural Experiment Station in order to collect data for this book. It is hoped to have it ready for publication some time during the coming winter.

THE date for the summer meeting of the American Ceramic Society has been set for October 6 and 7, at the Hotel Biltmore, Los Angeles, California. The morning and afternoon sessions will be devoted to the reading of papers and discussions. The dinner meeting will be on Tuesday evening. Railroad excursion rates will be granted with the usual stop-over privileges. For further information communicate with either Mr. Fred B. Ortman, chairman of the Summer Meeting, Tropico Potteries, Inc., Glendale, Calif., or with the general secretary, Lord Hall, Ohio State University, Columbus, Ohio.

ACCORDING to *Chemical and Metallurgical Engineering,* the International Union of Pure and Applied Chemistry has been invited to hold its 1926 meeting in the United States in conjunction with the fiftieth anniversary meeting of the American Chemical Society. Those of the members of the International Union who have been consulted in connection with the proposal say that the only objection is the expense, although it is admitted that many members of that organization would be willing to expend a reasonable amount for the education and experience that would result from it. Officials of the American Chemical Society now are conferring with the railroads to see what special rates may be obtainable for a special train which would convey the visitors, during their stay, to the principal centers of the chemical industry. It is believed such a plan, which would permit of their living on the train, would reduce the expense materially.

AN International Conference on Health Problems in Tropical America was held at Kingston, Jamaica, from July 23 to 31.

THE 1924 session of the Institut International d'Anthropologie will be held this year in Prague, Czechoslovakia, from September 14 to 21. The session will be held under the auspices of the Czechoslovak government and includes excursions to the famous caves and localities of ancient man in Moravia. To facilitate attendance, passport visa for members of the congress will be dispensed with, and a 50 per cent. reduction will be allowed for members and their families on all the railroads within the Republic. The congress will be devoted to all branches of anthropology and communications may be presented in any of the modern languages.

WE learn from *Nature* that the international Commission on Illumination held its sixth session at Geneva from July 21 to 25, under the presidency of Dr. E. P. Hyde. Twenty-six papers on subjects connected with illumination were presented, and delegates from America, France, Great Britain, Italy, Japan, Poland and Switzerland were present. The papers dealt with photometric nomenclature, primary standards of light, heterochromatic photometry, automobile and industrial lighting and legislation. As a result of the discussions, progress was made on a number of problems in which international agreement and cooperation is desirable.

THE twenty-third Flemish Congress of Natural Science and Medicine was held at Aalst on August 9 and 10.

THE Belgian Society of Hydrology will hold the next congress at Brussels, under the chairmanship of Dr. Modeste Terwagne, from October 15 to 17, 1925.

THE Department of Biology and Public Health at the Massachusetts Institute of Technology, beginning with the next college year, will offer the degree of doctor of public health to properly qualified candidates. The new degree will be placed on the same level as the degrees of doctor of philosophy and doctor of science, requiring, in general, at least three years of graduate work for those possessing the bachelor's degree.

A JAPAN Eugenics Society has been organized under the management of R. Goto. A monthly magazine, of which the English part of the title is *Eugenics,* is being published to spread the knowledge of eugenics in Japan.

THE Bureau of Mines radium laboratory has been set up in Washington after its transfer from Reno. This change in the location of the laboratory was made so that the work could be under the personal supervision of Dr. S. C. Lind, the bureau's chief chemist.

WORK has been begun by the Wisconsin Committee on the Application of Electricity to Agriculture, of which Dean H. L. Russell, of the College of Agriculture, is chairman. The experimental community selected is situated southwest of Ripon, starting near the city limits and extending out about six miles. About fifteen general farmers and two pea viners will have their farms electrified and studied. Accurate records on the use of all electrical equipment and specially made farm machinery will be kept and the results will be broadcast throughout the state.

It is believed the community will be visited by many thousands of farmers during the course of the experiments, which will be continued for more than a year. The high-voltage power line which will serve the farm electric laboratory is about completed, and within a very short time the farmhouses and barns will be wired for service.

ACCORDING to *Chemical and Metallurgical Engineering*, an appropriation of $90,000 will be asked of the Congress next December by the Bureau of Mines, for the purpose of establishing a plant in the field for the extraction of oil from shale, on which for several years the bureau has been engaged in laboratory experimentation. The estimate for this appropriation was submitted to the budget bureau several weeks ago and has been approved by General Lord, director of the budget, and by President Coolidge. The appropriation is to cover the construction of the plant, the land necessary for the plant and the securing, by purchase or otherwise, of the necessary shale or shale land.

SECRETARY OF THE INTERIOR WORK has recently taken steps to formulate a committee composed of representatives of the American Bar Association and leading patent bar associations of the country to simplify methods of procedure and expedite the business of the Patent Office. The plan of Secretary Work is to have the committee after its organization make a thorough review of the Patent Office and to submit suggestions for changes in methods that should result in bringing the work of the bureau to a current basis in the near future. Because of a tremendous increase in the patent business during the last few years, the Patent Office has been unable to keep up with the number of applications for patents that have been filed by the public.

ACCORDING to the scientific correspondent of the London *Times*, two Dutch investigators, Professors Paul Frosch and H. Dahmen, have succeeded in isolating the virus of foot-and-mouth disease, the virulent contagious malady of cattle which in recent years has threatened economic disaster to the stock-raising industry. It has long been accepted that the causative agent of this plague must be a living organism capable of surviving outside the body of cattle for a sufficient time to spread by unknown ways. The Dutch professors now have not only isolated the virus, but have been able to make pure cultures of it on solid media. Thus the first stage towards conquest of the disease has been reached. The method they have employed has been the use of the ultra-microscope and the taking of photographs by light-rays beyond the range of visibility.

ON July 1 the metric system became the official standard of measurement in Japan and was so announced in a recent imperial ordinance, according to advices to the Department of Commerce. The government for some time has been conducting an educational campaign in order to popularize the system and has staged demonstrations in various cities. The law does not contemplate the immediate universal use of metric units, since it is realized that it will require considerable time to overcome the numerous difficulties. The great majority of the Japanese people understand only the native units and are very conservative and prone to stick to old customs and habits. Furthermore, there are very formidable physical and financial difficulties to overcome. The replacement of the present scales used by the Imperial government railways, for example, will mean the purchase of several thousand new scales at an expenditure of possibly 1,000,000 yen.

The Medical Journal and Record states that, at the British Empire Exhibition now being held at Wembley, in London, there is a Tropical Health Department which is intended to give a graphic representation of the various diseases and to explain how they are caused and how they may be prevented. The disease section deals with twenty-seven diseases, and one portion is given over to those which are spread by biting insects. Photographs, pictures, models and specimens are employed to describe each disease, and a brief history and the existing means for fighting it are also given. Among these diseases are included such conditions as malaria and yellow fever. Another group includes those due to intestinal infection such as typhoid fever. Food deficiency diseases are represented by scurvy and beriberi. Much space is devoted to skin diseases, yaws and leprosy. The third section deals with hygiene and the fourth with plant diseases.

ACCORDING to the *Journal* of the American Medical Association the public-health committee of the New York Academy of Medicine has been making a survey in this city as regards the care of convalescent patients. A special report which this body has made on this "neglected phase of medicine" points out that there has been no serious discussion of the kind of care which the various types of convalescent patients require. There has likewise been no thorough consideration of the types of cases which should be cared for jointly, and which would harmonize from an administrative medical point of view. To remedy this the public health committee plans to study the convalescent needs of the city, with a special view to the framing of a community policy and developing medical and administrative standards for the guidance of convalescent homes. It plans to organize a central reference bureau to furnish information and to act as a clearing house, to facilitate a better distribution

of convalescent patients to the existing homes and hospitals, and to assure treatment best suited to each patient. The bureau will be financed by the Sturgis Research Fund and the Burke Foundation. The survey shows that the existing facilities are reasonably sufficient but that they are underutilized.

ACCORDING to *Nature*, arrangements have been made to establish at Oxford in October next the Imperial Forestry Institute, which is intended to serve as an educational and research center for the British Empire. It will be a university institution, with the professor of forestry as its director; but it will be under the control of a board of governors, with a forestry commissioner as chairman. The educational work of the institute will comprise (1) post-graduate training of forest service probationers and other qualified persons, (2) training of research officers in special subjects, and (3) provision of courses for selected officers already serving. The institute will be open to various categories of students, who must as a rule have had previous training at a university in forestry or some allied science. The normal course of study will extend over one academic year, and the subjects dealt with will cover the whole range of forestry.

NEW experimental equipment produced at the Cruft laboratories of Harvard University is being installed in a large DeHaviland plane for the purpose of dispersing fog or clouds. This includes sand boxes on each side of the fuselage, which are connected to batteries. By pulling a lever the electrified sand is released through a nozzle and sprayed over the cloud or fog bank which is to be exterminated.

THE *British Medical Journal* states that the reports on serological investigations presented to the Second International Conference on the standardization of sera and serological tests held at the Pasteur Institute in Paris in November, 1922, have been published in a volume of some 300 pages by the health organization of the League of Nations. The reports deal with the standardization of serums for diphtheria, tetanus, meningitis, pneumonia and dysentery, and with the sero-diagnosis of syphilis.

FOR the preservation of the only two herds of wood bison known to exist in a wild state, the Canadian government has set aside an area of five thousand square miles in the wilderness south of Great Slave Lake. Little has been known of these herds of wild wood bison until a party was sent out by the Canadian government in 1922 to get all available information. It was then learned that the number of bison in the northern herd is at least five hundred with twice as many in the southern herd.

A 26-INCH refracting telescope is to be installed at Johannesburg, South Africa, by Yale University, according to a report from Consul G. K. Donald to the Secretary of State. Yale's decision on the location of the telescope was largely due to the American Chamber of Commerce at Johannesburg. At its request, the minister of railways granted a 15 per cent. reduction in freight rates from the coast, the commissioner of customs and excise has promised to request from parliament free entry for the telescope and accessories, and the director of the union observatory at Johannesburg, besides affording the facilities of astronomical time service, dark rooms, etc., has promised a free site in its 15-acre reservation.

A FURTHER stage in the development of the Cast Iron Research Association was reached a few days ago, when the association formally took possession of its laboratories. These are situated in Guidford Street, Birmingham, and are equipped for the conduct of chemical analyses and general metallurgical and heat-treatment work. The capacity of the association to deal with its work will be greatly increased, but it is not intended to abandon the policy of having investigations conducted in prominent university laboratories and in the works of members. It is anticipated that the association, which commenced a new financial year on July 1, will incur an expenditure during the year of between £6,000 and £7,000. The research program includes important investigations on erosion- and corrosion-resisting cast irons; moulding sands; graphitization; heat-resisting cast iron; the production of malleable cast iron; cupola practice; cast irons for electrical and magnetic purposes; measurement of melting and pouring temperatures; the fundamental properties of cast iron; standardization of test bars, materials and methods; facing sands and blackings; cast iron to resist abrasive wear, and, jointly with the British Motor and Allied Manufacturers' Research Association, automobile cylinders and pistons.

UNIVERSITY AND EDUCATIONAL NOTES

THE Carnegie Corporation of New York has paid to Samuel H. Church, president of the Carnegie Institute of Pittsburgh, $8,000,000 provisionally promised four years ago, to be added to the endowment for the educational work of the institute. This makes the total amount given to the Carnegie Institute by Mr. Carnegie and the Carnegie Corporation $38,000,000.

IN connection with the incorporation of Rush Medical College as a part of the University of Chicago, the medical work on the quadrangles of the university has been organized under the name of the Graduate

School of Medicine. To emphasize and assure the scientific character of this school, it is not organized separately from the Ogden Graduate School of Science, but within that school as a part of it.

IT was stated in SCIENCE that Dr. A. Ross Hill had been elected president of the University of Oklahoma. Dr. Hill was offered the presidency some time ago, but was unable to accept. Dr. J. S. Buchanan, acting president since the resignation of Dr. Stratton D. Brooks to accept the presidency of the University of Missouri, was elected president at the meeting of the Board of Regents held on June 3.

C. M. CARSON, director of the department of chemistry, has been appointed acting president of the Michigan College of Mines, to succeed the late Dr. F. W. McNair.

N. HENRY BLACK, of the Roxbury Latin School, Boston, has been appointed assistant professor in Harvard University to teach physics and to organize courses on science teaching in the Graduate School of Education.

DR. R. B. STREETS, of the University of Wisconsin, has been appointed assistant professor of plant pathology at the University of Arizona.

DR. IVAN C. HALL, of the University of California, has been appointed professor of bacteriology at Cornell University, Ithaca.

DR. P. W. WHITING, research associate professor of eugenics, of the Iowa Child Welfare Research Station, has resigned to become professor of biology at the University of Maine.

E. A. MILNE, assistant director of the Solar Physics Observatory at Cambridge, has been appointed to the Beyer chair of applied mathematics at the University of Manchester.

DISCUSSION AND CORRESPONDENCE

THE USE OF SEA SALINES IN THE TREATMENT OF GLANDULAR (INCLUDING UNDOUBTEDLY GOITROUS) ENLARGEMENTS—HISTORICAL NOTES

IN a previous discussion upon the relationship between the purity of our dietary condiment known as "common salt" or "table salt" and the existence of endemic goiter, the writer believes he was the first one to draw attention (see this Journal, LIV, No. 1389, p. 131, August 12, 1921) to the significance of the geochemic phenomenon by which iodine has been largely leached from the soil of many localities and to the significance of the source of our present-day article, derived, as it is practically altogether, from inland deposits and brines rather than from sea water and "alkali" mineral springs, as was the former-day custom. I also pointed out the possible desirability of using a condiment consisting of total sea salts or even sea water in place of our table salt. The full results of my inquiries in this direction were published in the *Jour. Am. Med. Assoc.*, Vol. 78, 18–21, Jan. 7, 1922.

In the spring of 1922, Professor Raymond C. Osburn gave me an interesting reference from "Buckland's Log Book of a Fisherman and Zoologist," London, 1883, p. 161, to wit:

> Just one hundred and twenty years ago a very small but very remarkable book was published. The title of it was "A dissertation on the use of sea water in the diseases of the glands, particularly the scurvy, jaundice, king's evil, leprosy and the glandular consumption," translated from the Latin of Richard Russell, M.D., by an eminent physician. "The sea washes away all the evils of mankind," *Eurip.*, *Iphig. in Taur.*, v. 1193. London: Printed at Homer's Head, Temple Bar; and R. Goadby at Sherbourne, 1752.

It has appeared to me that some excerpts from Russell's book, necessarily unscientific as they are, might prove of interest, both historically and otherwise at the present time, especially in regard to the use of sea foods and sea salt in the preventive treatment of endemic adolescent goiter and perhaps other "deficiency diseases" which were, of course, unrecognized as such in his day.

Russell's original work was entitled *"De tabe glandulari, sive de usu aquae marine in morbis glandularum dissertatio;"* *3 p. l.*, 3–235 pp., 7 pl. 8° (oxoniae). *J. Fletcher et J. et J. Riverton,* 1750. At least four editions of this work, translated into English, appeared under dates as follows: 1752, 1753, 1760 and 1769. The edition of 1753 reached 398 pages. That of 1760 contained also "A translation of Dr. Speed's commentary on Sea Water." The following are taken from the 3rd English edition (1760):

> By sea water joined with other medicines, the Glands may be successfully purged, and freed from Obstruction —p. 7.
>
> The Patient will bear the Stimulus of the Sea water six months and, in Disease of Skin, I have known a Patient bear it tolerably well for a whole year. * * * But Sea Water will heal many Diseases where Mercury is of no service—page 8–9.
>
> Drink a pint of Sea water next A. M., (for gonorrhoea)—p. 61.
>
> [Dr. Speed] As the Use of Sea Water has grown in Fashion * * * I determined to try Experiments on the waters that washed the shores of that County [Hampshire]—p. 145.
>
> The Ancients were very cautious in giving it inter-

nally and Dioscorides (*Med. Mater., lib. V, cap. 23*) acknowledges sea water was given internally as a purge by itself. He recommended: Equal parts of Honey, Sea and Rain Water: also Wine made with sea water to purge the body, also to relieve those who spit purulent matter, and those that are costive. * * * In *de Parabilibus*, he affirms that sea water drank with Oxymell will break internal abscesses.—p. 150.

Half a pint of Sea Water drank at night going to Bed repeated in the Morning, is generally enough for Adults—p. 153.

For the glands of King's evil—operate and use Sea Water both internally and externally (as embrocations). [Many case reports given]—p. 156.

From what has been said it will appear that this method of cure is no invention of the Moderns, but was known to the Father of Medicine while it was in its infancy—p. 171.

It would appear, therefore, that the idea of using sea water or sea salts for medicinal and health purposes was a custom well established in former times, but one which a careful examination of medical and health literature of the present day shows has been quite discarded (in favor of "purified products"). Instead of the "old fashioned salt" derived by evaporation of sea water and retaining a trace or more of the thirty-odd elements said to be present in sea water, entirely new and also far cheaper source-methods of salt supply (from mines and brines of inland sources) is now the plan, and as a result we have a purified article, *sodium chloride*. Thus, as I have suggested in my previous articles, we have possibly created a condition of iodine and other elemental starvation purely by our commercial procedures. Should we not pursue a "back to nature" plan in this matter, as is advocated in connection with some of our vitamin-free food articles? Necessarily more scientific investigation is still essential to substantiate this, but observational evidence on all sides is strongly in support of it.

Emery R. Hayhurst
Ohio State University

THE CURE AND PREVENTION OF EAR CANKER IN RABBITS

One of the many serious chronic diseases of rabbits that may interfere with the use of this animal in laboratory work is "ear canker." This disease may seriously handicap or cripple research, especially experiments requiring months or years of observation on the same animals.

Ear canker is caused by an animal parasite (*Psoroptes cuniculi*) which closely resembles the mite (*Sarcoptes cuniculi*) causing scabies. Curiously, it attacks only the concha of the ear. The earliest manifestations of infection are indicated by hyperemia and the formation of reddish brown crusts near the bottom of the concha. The hyperemia and crust formation extend and after months may involve nearly all the inner surface of the ear. The most serious complication of the disease is pyogenic infection of the middle ear which may extend to the internal ear and meninges. The parasite spreads more rapidly during the warm months. The disease is widespread, and few, if any, laboratories escape its occasional introduction.

The usual methods prescribed for treatment involve isolation and are elaborate and costly. For many years we have been treating the infection in important animals by the time-honored plan of removing the crusts and swabbing the concha with glycerine containing 2 per cent. carbolic acid. This method, as with many others of the same type, is tedious and time consuming. Last June (1923) when the laboratory was heavily stocked an extensive outbreak occurred, both in the old and the young stock. In casting about for some quick means of attack, we decided to try kerosene on account of its powerful insecticidal action. This was sprayed into the ear with a small De Vilbiss atomizer. Each ear received the amount of kerosene spray discharged from three or four compressions of the bulb or sufficient to moisten only the inner surface of the ear. The ears were sprayed twice, with an interval of six days. At the end of two weeks all the rabbits were cured of the infection and no case has since developed in our rabbit colony, averaging about 200 animals. It is doubtful whether the second spraying was necessary.

We have been prompted to call the attention of other laboratory workers to this well-known infection for the following reasons: (1) This experience was one of the most striking therapeutic effects in mammals we have ever witnessed; (2) Kerosene spray affords a specific, cheap, simple, rapid and certain means, both of curing and preventing the disease.

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THE MEANING OF CONSERVATION

In an article entitled "Two kinds of conservation," published in *The Scientific Monthly* for March, 1924, Dr. E. E. Slosson makes a statement which, in my opinion, is likely to help to perpetuate an old misconception of the meaning of conservation as applied to natural resources—a misconception which Dr. Slosson probably does not share. The likelihood is increased by the fact that the statement is strikingly clear and forceful—as is usual with what Dr. Slosson says—and is almost but not quite correct.

Dr. Slosson says, "The conservation of oil means not using it, for all the oil that is used is forever lost.

The conservation of water power means using it, for all the water power that is not used is forever lost."

The first eight words of the statement could be used by anti-conservationists in opposing conservation activities on the grounds that the latter require the present generation to suffer for the benefit of future generations. Regardless of the moral status of such a requirement, it is practically certain that no "present generation" would submit to it.

For fifteen or twenty years, America's most effective conservationist, Mr. Gifford Pinchot, has found it necessary to disabuse people's minds of the misconception that conservation means disuse. As recently as May 17, 1924, in an article in the *Saturday Evening Post,* Mr. Pinchot said:

> Let no man persuade you that conservation and stagnation are the same. From the beginning conservation has meant wise use in the public interest, and it means wise use to-day. This generation has a right to all it needs, but no right whatever to waste what it does not need. Our children have their rights as well as we. If there was ever a policy since this world began that was simple, sound and filled with common sense, it is the policy of conservation.

Mr. Pinchot explains in the same article that the oil deposits *in the national reserves* need not be exploited *now.* The reason obviously is that the oil in them is not now needed. But conservation should include privately owned as well as publicly owned oil deposits, just as it should include privately owned forests. Private oil properties are sufficient for present needs and as Pinchot says, "This generation has a right to all it needs, but no right whatever to waste what it does not need."

As a definition of conservation, Dr. Slosson quotes from Acheson: "Conservation consists in the utilization of the inexhaustible for the preservation of the exhaustible." This sounds attractive and it perhaps describes a laudable ultimate ideal. But for economic, physical or other reasons, its practical application is impossible in meeting many of our greatest and most urgent needs, with the knowledge now available. In my opinion a more workable though rougher definition which is readily inferred from the writings of Roosevelt, Pinchot and other great conservationists is, "Use without waste and, wherever possible, with replacement."

The great problem in the conservation of exhaustible resources is to find and to apply feasible methods of increasing the efficiency of utilization, which is about the same as saying to find and to apply feasible methods of reducing waste.

F. D. Farrell

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The eight words of mine that Dean Farrell criticizes, "The conservation of oil means not using it," are literally true, yet I did not intend them to be taken literally. To keep the oil in the earth would indeed conserve it—if nobody tapped the pool—but it might better have been used up than to remain forever unused.

I am reminded of the poor woman whom a philanthropic visitor found in the slums. She had five small children and one at the breast; her husband had broken his leg; she was out of food and fuel and was about to be evicted from the flat for non-payment of rent. Yet she boasted of having five hundred dollars in the savings bank and when the visitor asked why she did not draw out some of it she replied that she was "saving it for a rainy day."

I really did not anticipate that any reader of *The Scientific Monthly* would suspect me of advocating such an extreme form of conservation. And I hasten to add—lest I be called before the Senate Investigating Committee—that I was not talking about oil especially, but discussing the general principle of conservation applicable to coal, certain metals and minerals, and any other natural resources that are limited and irreplaceable.

Yet I may confess that I believe the day is coming —and I hope to live long enough to see it—when it will be wise to prohibit the burning of petroleum and natural gas because they will be found indispensable as material for the manufacture of organic compounds, possibly even food since edible fats have been made from petroleum. If that be treason, make the most of it.

Edwin E. Slosson

Science Service
Washington

MR. W. E. MYER'S ARCHEOLOGICAL COLLECTION

The late W. E. Myer, of Tennessee, served as volunteer assistant in the Bureau of Ethnology for several years. For about forty years he had made studies of the archeology of the Tennessee and Cumberland river valleys. Dr. J. Walter Fewkes, head of the bureau, told me last May that the bureau had lost a most efficient and valuable worker. Myer was one of the few men in the United States who was familiar with prehistoric cultures throughout the main Mississippi valley. He has left an important work in manuscript form embodying detailed studies in Tennessee archeology.

Up to the time of Mr. Myer's connection with the bureau, he carried on extensive researches at his own expense. He very carefully recorded all specimens

found. He left his heirs some 15,000 or more stone, bone, shell, clay and copper artifacts of aboriginal workmanship. These include many interesting engraved shells, decorated copper plates, effigy pipes, etc. It is doubtful whether Myer's collection could be duplicated in the state of Tennessee, since most of the monuments and graves have been explored.

The heirs wish to have Mr. Myer's collection preserved intact in some museum. It has been highly recommended by Dr. Neil M. Judd, of the Smithsonian, Dr. Fewkes and others. Mr. Myer's son, Mr. W. H. Myer, care of Frazer & Co., 30 Church Street, New York, N. Y., has the matter in charge and will be glad to correspond with any museum officials who are interested.

WARREN K. MOOREHEAD

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SCIENTIFIC BOOKS

Illustrated Flora of the Pacific States, Washington, Oregon and California. By LEROY ABRAMS. Vol. 1. Stanford University, California, Stanford University Press, 1923. xii + 557 pp. $9.00, prepaid.

A DESCRIPTIVE flora is primarily for the purpose of enabling one to identify the plants of the region covered. But some go farther than this and aim to give also new information regarding the plants themselves. Professor Abrams' flora is distinctly a work of this latter sort and is to be classed as a valuable contribution to knowledge of the morphology, relationships and geographic distribution of the species growing spontaneously in the three Pacific Coast states. The flora of this region has been so little studied, as compared with that of other parts of the United States, that numerous readjustments in the classification are necessary if an author is to present anything more than a compilation of previously recorded facts, and in the present instance his intimate field acquaintance with the flora and his access to types in eastern and European herbaria have enabled him to prepare what is essentially a critical revision of each of the genera treated.

But this assembling of new material has not been permitted to interfere with the more immediately practical values of the book. The style and general make-up are frankly patterned after the well-known illustrated Flora of the Northern United States and Canada, by Britton and Brown. Consequently, each species is illustrated by a text figure as well as keyed and described and the distribution and principal synonyms are clearly given. It is confidently predicted that, as in the case of its prototype, the figures will greatly add to the popularity of the work and that many users who would otherwise prefer a more conservative treatment of genera and species will be led to adopt the accompanying names.

In the matter of generic and specific concepts, the author has not gone to the extreme in either direction, although there is a decided tendency towards the acceptance of generic segregates and "small species." The nomenclature follows the rules now under consideration by the American Botanical Society and recommended by its nomenclature committee (of which Professor Abrams is a member). There is here a splendid opportunity for comparing the results with those obtained when the International Code and a more conservative treatment of genera and species are followed, for Professor W. L. Jepson, who in the main follows the latter code and who is moderately conservative, has recently covered most of the same area and the same families in his "Flora of California." Since much of this first volume of the Abrams flora has been contributed by collaborators, some of whom also contributed to the Jepson flora, it is necessary to select for comparison some portion of each book prepared by the author himself. Consequently the Liliales and Orchidales have been chosen as furnishing a fair comparison, and all non-Californian forms have been excluded, since these are not covered by Professor Jepson's work. In the two orders named, Abrams gives 8 families, 57 genera and 255 species, whereas Jepson has 5 families, 45 genera and 225 species. Furthermore, there are 55 additional cases where the plant names differ, although the authors are in agreement as to specific limits. The final result is that if one were to use Abrams's flora and then turn to Jepson's, he would find that of the 255 plant names accepted in these orders by the former, only 170, or about 67 per cent., are given full recognition by the latter. The remaining 85 names, or 33 per cent., would need to be sought among the synonyms and a considerable number could not be found even there.

In attempting to discover the reasons for these differences, it develops that 29 per cent. of the cases of non-agreement are traceable to differences in the rules of nomenclature followed by the respective authors, while 71 per cent. are due to differences of opinion as to what constitutes genera and species. It seems, therefore, that an agreement among taxonomists as to rules of nomenclature, although much to be desired, is perhaps only secondary in importance as compared with the need of an agreement on generic and specific limits.

On analyzing the situation farther, it is found that, at least as between these two authorities, the shifting of generic lines is responsible for as many name changes as is the difference in species concept. What an enormous amount of confusion would be avoided if all systematists were to apply the principle

of leaving established genera intact, except in those instances where they are composed of unnatural assemblages of species. Such procedure has been especially advocated by Dr. Robinson.[1] What a saving of energy this would mean—energy that could then be applied to the fundamental problems of plant classification! It may here be noted that this shuttling back and forth of botanical names is not science and that time spent upon it might well be given to the real problem of the taxonomist, namely, the determination of relationships, or, in other words, the construction of a natural classification based upon phylogeny and supported by evidence from every possible source, including experiment, statistics and the paleontologic record.

In putting out a flora of this sort, the author often encounters forms which are not of sufficient value to be ranked as species but which are, nevertheless, too important to be entirely ignored or to be relegated to synonymy. Professor Abrams has wisely adopted the expedient of assembling some of these under those species of which they are evolutionary derivatives and of printing the name and the brief description in small type. By this method the user of the book is permitted a choice between the segregate name and the one given for the inclusive species. It is quite probable that for some purposes the one will be the more useful, while in other connections the alternate name will be chosen. In the reviewer's opinion, the book would find a far wider field of usefulness if the accepted species were made much more inclusive and more advantage taken of the subordinate category. By this means the number of full species would be considerably reduced, an outcome much desired by the non-specialist, and the segregate names would still be available for those who might find use for them. If, in addition, the more important of these latter were to be treated as subspecies or varieties their relationships to the parent stock would be immediately evident in the trinomial used for their designation. Under this procedure only the limits of the collective species would need to be agreed upon while the minor categories could be modified to meet special needs without disturbing the binomial. It is evident that some such plastic arrangement must be worked out if botanical nomenclature is to attain its fullest value.

The first volume of this important flora, which is to be completed through the issuance of two more, begins with the *Ophioglossaceae* and ends with the *Aristolochiaceae*. It thus includes all the ferns and fern allies, the gymnosperms, the monocotyledons and most of the apetalous families of the dicotyledons. Portions of the text were supplied by specialists, as follows: *Pteridophyta* (except *Isoetaceae*) by William R. Maxson, *Isoetaceae* by Dr. Norma Pfeiffer, *Poaceae* by Professor A. S. Hitchcock, *Cyperaceae* (except *Carex*) by Dr. N. L. Britton, *Carex* by Mr. K. K. Mackenzie, and *Salix* by Dr. C. R. Ball. Dr. F. V. Coville assisted in preparing the text of the *Juncaceae*. In matters of typography, illustration, index, etc., the book is all that can be asked for. It is hoped that the succeeding volumes will appear as rapidly as the painstaking methods of the author will permit.

Harvey M. Hall

[1] Robinson, B. L., 1906, Science, N.S., Vol. 23, pp. 81–92.

LABORATORY APPARATUS AND METHODS

A MODIFICATION OF RECONSTRUCTION METHODS

After reconstructing several chondrocrania models of beeswax, which proved to be a laborious task, the writer has succeeded in perfecting a method that eliminates the unpleasant but necessary details of making the plates which are required in the older methods where wax is used, and at the same time shortened the process of construction without sacrificing accuracy.

This method differs from that described by Sussana P. Gage ('07), in the *Anatomical Record,* Vol. I, page 166; in that strawboard is used instead of blotting paper, and beeswax in the place of pins and nails, as the principal substance for fastening the sections together. Wire is necessary as an additional support only in the larger models where special stress occurs.

Strawboard is considered preferable to blotting paper where the sections are cut fifteen micra or more, as it may be obtained in practically any desired thickness at almost any print shop, thus avoiding the necessity of two or more thicknesses to represent each section, as may occur where blotting paper is used. Strawboard is more firm than blotting paper and is considered by the writer to be less easily distorted. Standard grade number 40, which is approximately two millimeters in thickness, has been used with satisfactory results in the construction of several models, which vary from four to seventeen inches in length. Camera lucida outline drawings of the parts to be modeled are made on the strawboard and a sewing machine is employed to make a perforated pattern of the drawn parts with the needle of the machine piercing the holes close enough together that separation along the lines may be practically complete. The pieces cut out, however, usually retain their position, until intentionally removed. Before each piece is placed in the model,

the part on which it is to rest is given a thin uniform coating of melted beeswax, then the new part is added, pressed down and held in position for a short time until the wax hardens. After the model is thus built up the exposed surfaces are covered with a thin coating of wax, which on hardening smooths the surface and tends to prevent injury from excess moisture.

One objection to reconstructions made entirely of wax is that they are very apt to become distorted when exposed to the variable temperature of an ordinary room. Models constructed as described above are not so easily affected, since the beeswax between the strawboard sections is protected. Such models are also lighter, easier to handle, and not so liable to injury when packed and shipped as are the wax ones. In this respect they differ little from those made of blotting paper. The greatest advantage over both the wax and blotting paper methods is the rapidity with which a reconstruction can be made, without the sacrifice of accuracy. The fact that the blanks are easily preserved makes possible their use at a later time in checking over the details of the model, which often is of great assistance.

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INEXPENSIVE LANTERN SLIDES FOR TEXT OR TABULAR DATA

It is often desirable to project text, mathematical formula or tabular data upon a screen for purposes of class instruction or during the presentation of a paper at a scientific meeting. Use of a lantern saves the time of the instructor which would be necessary to inscribe the data on a blackboard and also makes for greater accuracy and legibility. The obvious drawback to the use of the lantern lies in the cost of photographed lantern slides.

I have found that very satisfactory slides may be prepared by making use of the ordinary "Dermatype" stencil sheets such as are used for mimeograph work. The data are cut on this stencil by the bare type of a typewriter so as to occupy an area on the stencil measuring approximately 7 x 8.5 cm. By the use of elite type, rather extensive tables can be printed within this space. A portion of the sheet, with the data in the center, measuring 8.5 x 10 cm, is then cut from the stencil by a sharp knife or a safety razor blade and mounted between two thin sheets of glass of the same dimension. Black paper tape is later used to bind the edges of the glass.

Such a lantern slide projects light figures or letters on a light blue background, the data being plainly visible even in a fairly well-lighted room.

Such lantern slides are permanent and can be prepared at a cost for materials of approximately five cents each.

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SPECIAL ARTICLES

SPECIFICITY IN FERTILIZATION

The results of experiments that I completed while working as a research associate of the Carnegie Institution of Washington, at the Misaki Marine Biological Station of Tokyo Imperial University, add to our knowledge of the factors controlling specificity in fertilization.

The methods devised made it possible to eliminate cortical block to activation in every cross-activation attempted, and to obtain better than 90 per cent. early development in all cross-activated material. This percentage of cross-activation is unusually high, but the especial significance of the results lies in the fact that of thirteen cross-activations made, eight were from four pairs of reciprocal crosses. It is well known that the facility with which a cross-activation is made in one direction is no indication of the degree of success which may be anticipated with the reciprocal cross.

All the work was done with echinoids. The preliminary studies of species fertilization revealed the fact that the eggs of *Heliocidaris tuberculata* did not form a separated fertilization membrane, and that the eggs of *Temnopleurus toreumaticus,* shortly after insemination, contracted strongly within the fertilization membrane, not to resume their normal rounded form until just prior to the first division.

We think of developmental reactions in terms of eggs. Ordinarily, we endeavor to give the egg such treatment that it will follow its own normal course of development. These experiments followed a different plan. I decided to inseminate the *Heliocidaris* egg with *Temnopleurus* sperm and then attempt to make this egg show the reactions that are normally shown by the *Temnopleurus* egg following species activation, namely, to form a separated fertilization membrane and to contract strongly a few minutes after activation.

To state the matter in another way: After some comparative study I took as a working hypothesis the idea that sperms differ in degree, at least, in their effect on the egg. The effect produced by a spermatozoön on the egg of its own species may be called, for convenience, its natural effect. The work done by a spermatozoön in producing the natural effect is an indication of the natural potency of the spermatozoön.

Proceeding on the idea of using sperms as units of an *activating substance,* the plan of supplementing the natural potency of a spermatozoön by increasing or by diminishing its task was tried. A spermatozoön was regarded as having a definite amount of energy, an amount which might be sufficient, or too much, or not enough to produce the effect desired, and which, therefore, may be used as it is, or its task made more difficult or easier, as the occasion demands. In other words, it was decided to grade the spermatozoa to different degrees of activation by indirect means. What really was done was to grade eggs to the natural potency of the spermatozoön.

Seven cross-activations of the egg of *Heliocidaris tuberculata* were made. In no two of these was the necessary treatment of the egg the same. *Heliocidaris* eggs accept species activation readily in unmodified sea water; they must be treated with solutions that are regarded as increasing their permeability before they can be activated by, *e.g., Temnopleurus* sperms; while they must be treated with solutions that are regarded as decreasing their permeability, before they can be activated by, *e.g., Astriclypeus* sperms.

Heliocidaris and *Temnopleurus* are both regular echinoids. They belong to different families of the same sub-order. A cross between them is therefore of inter-family width. *Astriclypeus manni* is a Clypeastroid. A cross between *Astriclypeus* and *Heliocidaris* is therefore inter-ordinal.

HELIOCIDARIS ♀ × TEMNOPLEURUS ♂

For this cross-activation the following method was used:

(1) Eggs inseminated in 100 cc sea water + 2 cc 2½ M NaCl, and transferred to

(2) 100 cc sea water + 6 cc 2½ M NaCl. The eggs separated membranes in this solution. Transferred to

(3) 82 cc sea water + 18 cc 2½ M NaCl. This solution produced a strong contraction of all eggs which had formed membranes. Transferred to

(4) Sea water. 90 per cent. of these eggs underwent regular cleavage.

Step (2) was necessary for the removal of internal block to the fusion of the germ nuclei.

HELIOCIDARIS ♀ × ASTRICLYPEUS ♂

For this activation the eggs were washed in sea water and placed in

(1) ⅝ M $CaCl_2$ for 3 minutes; then transferred to

(2) 800 cc sea water + 5 cc n/10 NaOH + *Astriclypeus* sperms; after 3 minutes transferred to

(3) Sea water.

All the eggs formed perfect membranes and segmented regularly. ⅝ M $BaCl_2$ and ⅝ M $SrCl_2$ were used in place of $CaCl_2$ and gave the same results. Segmentation did not take place unless the eggs were transferred to a considerable volume of sea water, as indicated, following the treatment with $CaCl_2$, $BaCl_2$ or $SrCl_2$.

The control in both cases consisted of eggs receiving the respective treatments described above, but with insemination omitted. Without insemination, no membranes were separated and cleavage did not take place. The methods were not interchangeable. *Heliocidaris* eggs were not activable by *Temnopleurus* sperms following the treatment with $CaCl_2$, nor were they activable by *Astriclypeus* sperms following any treatment with NaOH or NaCl, or any combination of these that was tried. On the other hand, *Heliocidaris* eggs which have simply stood in sea water for four hours will, when inseminated with *Astriclypeus* sperms, give as high as 95 per cent. regular segmentation.

These two examples represent the two types of treatment which were found to be necessary in order to obtain cross-activation of the eggs of *Heliocidaris* by the various sperms used. In five of the seven cross-activations of this egg which were made, a preliminary treatment of the egg with NaOH or NaCl or a combination of NaOH and NaCl, a treatment which may be looked upon as increasing the permeability of the egg, was necessary. In the two remaining cross-activations it was necessary to give the egg treatment with solutions of the divalent salts of the alkaline earths, which are regarded as decreasing the permeability of the egg.

Having determined that the sperms used in these activations may be divided into two groups on the egg, it is of interest to find whether this grouping on a physico-chemical basis can be related to any other determinable differences. The only other evident difference is the difference in size of eggs of the different species used. *Astriclypeus* and *Peronella* sperms, the two which form the smaller group, are from species having large eggs. *Peronella* eggs are from .3–.4 mm in diameter. The other group contains sperms from species having eggs that are comparable in size to those of *Arbacia, Strongylocentrotus purpuratus, Lytechinus variegatus,* etc. The idea of natural potency and the relative mass, or the relative surface of the egg to be activated therefore suggests itself. Any discussion of this idea, at this time, would be little more than speculation. There is simply the evidence that *Astriclypeus* and *Peronella* sperms produce too great an increase of permeability when used with small eggs, for activation to be successful.

Six cross-activations of eggs were made with the sperms of *Heliocidaris.* In every instance the only treatment found to be necessary was insemination in sea water to which NaOH or NaOH and NaCl had been added. If this treatment increased the perme-

ability of the eggs, there were differences of degree of increase necessary. *Heliocidaris* sperms seem to be low in ability to increase permeability. The fact that *Heliocidaris* eggs, when species fertilized, form no separated membranes, together with the fact that when *Heliocidaris* sperms are used as cross-activators the eggs must be graded to the natural potency of the sperms by being given increased permeability, support such a conclusion.

The most striking features of the results, when they are viewed as a whole, is their emphasis of the fact of the specificity of the spermatozoön in the activation of the egg of its own species. The idea of the specificity of the spermatozoön in fertilization is one whose truth has been assumed, rather than established. My working hypothesis, that sperms differ in degree, at least, in their effect on the egg, has been established as a fact by the evidence of the experiments. The sperms of each species were found to have a characteristic natural effect. The eggs of different species had to be graded to the natural potency of the sperms.

Somewhat subsidiary to the larger aspect, but closely related to it, is the suggestion as to the nature of sensitization of the egg to activation. Loeb, Robertson, A. R. Moore and others have used $BaCl_2$, $CaCl_2$ and $SrCl_2$ to sentitize sea urchin eggs to activation by blood serum, oöcytin, foreign sperms, etc. Is sensitization more than a process of grading permeability?

At first sight there seems to be lack of harmony between my conclusions and those of Professor Loeb, stated in "The Organism as a Whole," "that the specificity which allows the sperm to enter an egg is a surface effect which can be increased or diminished by an increase or diminution in the concentration of OH as well as of Ca" (p. 77), and "that if the concentration of calcium was increased it was not necessary to add as much NaOH" (p. 74). If we refer to Loeb's fuller consideration of this subject, *Archiv f. Entw-Mech.*, Vol. 40, 1914, p. 318, the matter assumes a different aspect. Loeb found that the addition of calcium led to an increase in the number of eggs which formed membranes, but to a decrease in the number which developed. Insemination following straight NaOH treatment gave 90 per cent. membranes and 60 per cent. development. Insemination following $CaCl_2$ + NaOH treatment gave 100 per cent. membranes and 8 per cent. development. If the eggs were given a preliminary treatment with HCl for the purpose of removing the chorion-like jelly layer of the egg, and then inseminated in sea water + $CaCl_2$ + NaOH, about 80 per cent. membrane formation and development followed (*loc. cit.*, pp. 319–20). The use of HCl introduced a new factor, a factor which is not negligible, which was not considered in its relation to other reactions.

But it is on the basis of comparison of Loeb's observations on the results following insemination after straight NaOH and straight $CaCl_2$ + NaOH treatment, with my own, that the explanation of the differences seems possible. It seems to be a question as to whether the membrane has been formed as a result of activation by a spermatozoön or for another reason. Loeb found that the addition of $CaCl_2$ led to an increase in the number of eggs which formed membranes, but that few of the eggs developed. In my observations *Astriclypeus* eggs, *without insemination*, formed membranes upon treatment with $CaCl_2$; while *Heliocidaris* eggs, treated with $CaCl_2$, formed membranes only after the eggs were inseminated. In one case the membrane was formed by the action of the $CaCl_2$ solution alone, in the other it was the result of activation by a spermatozoön. It is possible that Loeb was dealing with similar material.

This raises the question as to whether development, in the material with which I have been working, was parthenogenetic or was the result of fertilization. The controls showed that development occurred only when the eggs had been inseminated. It is safe to say that activation was effected by sperms. I was able to remove internal block, when it occurred, by secondary treatment with NaCl. In the eggs of some species, it was possible to see the fusion of egg and sperm nuclei; in other eggs such an observation was impossible. The eggs were activated by sperms, but whether true fertilization or false fertilization and a subsequent elimination of paternal chromatin occurred is a question that can be answered only by cytological examination of fixed material.[1]

There is constantly increasing evidence supporting the belief that NaCl increases the permeability of protoplasm, while divalent salts, such as $BaCl_2$, $CaCl_2$ or $SrCl_2$, decrease its permeability. It is therefore logical to conclude that with one group of sperms activation occurred when the permeability of the egg was increased, and with the other when its permeability was decreased.

Permeability to what? Let it be clear that I mean permeability to water, ions and salts, and not penetrability to sperms. Given the intimate contact that is afforded by agglutination, penetrability is understandable. R. S. Lillie, McClendon and others have shown that fertilization is accompanied by an increased permeability of the egg. The present results indicate that one of the factors conditioning the fertilization reaction is a specific degree of permeability.

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[1] The material which the author collected for an investigation of this kind was destroyed in Yokohama on September 1, in the fire following the earthquake.

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CHEMISTRY AND THE STATE[1]

IT should be premised that in this account of the relationship of the state to chemistry in Great Britain an attempt has been made to limit it to a description of the more or less direct assistance given by that science to various departments as they came into being or took form. Only in recent years, and as a result of the war, has there been a direct recognition of a corresponding obligation on the other side.

It is obvious that it is to the universities, and, as was the case to a greater extent in the past, to private workers, that the great advances made by British chemists are due. Departmental requirements have, of course, reaped the advantage of these advances, but examples of important contributions to chemical knowledge emanating from the departments themselves are not lacking. The collected story of their connection with the activities of the state may be worth reciting, if it should show the development of its appeal to chemistry and illustrate the gradual breakdown of the view held by the chief of the tribunal before which Lavoisier came that "the state has no need for chemists."

We will find that their employment in an official capacity was in the first instance in connection with the state's pressing necessities, such as its defence, the regulation of its currency and the collection of its revenue, all of them subjects warranting the maintenance of equipment and staff.

As the need for safeguarding the nation's health, well-being and the quality of its food supply became recognized, legislation followed, frequently based on the work of commissions on which sat distinguished chemists of the day, and it became necessary to set up a state chemical department to assist in carrying this into effect.

For some time the science of chemistry had received a limited and vicarious assistance from state grants to the late science and art department and to the universities, but it was reserved for the war to establish definitely and finally the position that the whole future existence of a state might and probably would depend on the existence of a flourishing and efficient chemical industry. This resulted in the definite steps of assisting the application of science to industry and providing direct encouragement for workers in the purely academic field.

It is proposed, therefore, to sketch the develop-

[1] From the address of the president of section B—Chemistry—of the British Association for the Advancement of Science, Toronto, August 7, 1924.

ment of the main chemical activities of the state and to review the conditions in Great Britain in the hope that it may be of use generally to define the present position, and perhaps of interest to this Dominion in the present stage of its chemical development.

* * * * *

In the middle of 1915, at a time when our shortage of many essential materials brought out the need for the application of more scientific methods to our industries if we were to succeed in competition with other countries after the war, the Department of Scientific and Industrial Research was founded. It set out to assist firms in an industry to cooperate with one another and employ a staff of scientific men to solve their problems and develop their industry, to assist other government departments desirous of having investigations carried out, to organize research into problems of practical utility of wide importance and to foster the prosecution of researches in pure science. With the exception of the last, these aims can be considered as coming under the designation of organized applied research. The department has always strongly insisted that it is this type of work only that it seeks to organize, the assisted worker in pure research being left entirely free to follow his bent.

As regards scientific policy, the minister in charge of the department is advised directly by a council of independent scientific men, and these are represented also on the various boards and committees entrusted with the supervision of such investigations as are directed by the department itself.

Research Associations

From the success attending applications of scientific research in military and industrial problems during the war, the lesson was drawn that our industries in peace time should be infused with fresh and more vigorous life by methods which had proved their worth at our time of need. Foresight in these matters was necessary, since it behooved Great Britain, no longer with the industrial world at its feet, to make the utmost use of its resources by adopting the methods that were most efficient and solidly based on science, in order to produce material that would maintain the tradition of the excellence of British goods. While it was recognized that the most powerful chemical industries maintained efficient research staffs, it was decided to encourage separate industries to organize themselves for the cooperative prosecution of research. To the associations erected under this scheme grants, for a term of years only and usually on a pound-for-pound basis, are made from a fund of a million pounds voted by Parliament in order to demonstrate to the industries the advantage of investigating their own technical problems, for it was recognized that many industries would have to carry out research themselves before they could properly appreciate its application.

In its last published report the department remarks on the continuance of these grants to the associations beyond the originally intended period of five years, as this period has proved insufficiently long for the equipment of laboratories and the effective launching of important investigations, especially during a time of industrial depression.

A very wide field is covered by the research associations. Among those that have been set up in which chemistry is important are associations for the textile industries, for rubber, leather and shale oil, for flour and sugar, for non-ferrous metals, cast-iron, glass, refractories and Portland cement, and for scientific instruments and the photographic industry.

As the results obtained by the associations are primarily for the benefit of their constituent members, the onlooker has a chance of gauging the chemical work carried on only from the communications which, following an enlightened policy, the management of some of them permits to be published; and as many of these are contributions to "pure" chemistry, an example is afforded of the opportunity as well as of the necessity for work of this kind in the case of investigations undertaken primarily for an industrial purpose.

It would be impossible to review the work of the research associations for all these industries, even if the data were available, and so reference will be made only to some of their publications, including those of the group which is concerned with the textile fibers, cotton, flax, wool and silk, as the work published presents many interesting features. Thus there are being studied the products of the hydrolysis of cotton, with an obvious bearing on the constitution of cellulose, the chemical constituents of cotton-waxes, and the action of micro-organisms on cotton fibers and fabrics. Flax, hemp and ramie fibers are being investigated as to their distinguishing characteristics and behavior with reagents that affect their luster and absorption of dyes. Wool has been found to have a selective action, whereby it absorbs the alkali from the soap used in scouring, and methods have been evolved for accurately following the action in practice. Similarly with silk, a systematic study is being made of the action of acids and alkalis on the components of this fiber. In the respective laboratories the chemical and physical properties of each of these fibers are being studied and correlated for the purpose of explaining, for example, their strength and luster, and at a recent meeting of the Faraday Society the methods and results of workers in all these fibers were reviewed in a general discussion.

A close scientific scrutiny is being applied to the tanning of leather and the chemical and physical changes involved, together with a bacteriological study of the process. Equally important for this industry and for that of making photographic plates is the study of gelatin, whose chemical and physical properties are being elucidated, while work of benefit to pure science has been published on the effect of light on the photographic plate.

The study of the chemistry of glass and the physical properties associated with changes in its composition is another example of work that has been reported in the literature for improvement of an industry.

The record, as has been stated, must be incomplete, but the subjects mentioned present the appearance of being valuable in the scientific study of material and process and can scarcely fail to lead to the betterment of the respective industries.

Boards

The boards and committees under the department may be broadly divided into those which undertake the investigation of work of national importance and those which undertake work of specific importance to government departments and correlate the scientific work that these carry out.

A large amount of chemical work is carried out by these boards. The departmental research boards and committees dealing with chemical subjects are concerned with the cause of the deterioration of fabrics by organisms and light, and their fireproofing; with the changes that food undergoes under varying conditions of storage and the constitution of fats; with the chemistry of the treatment of timber; with the survey of our coal resources and the economic usage of coal; with the production of alcohol and liquid fuel from waste vegetable matter; with the chemical aspects of the problems of adhesion, lubrication, restoration of museum exhibits; with building materials, paints and the preservation of stone, and with the properties of several of the minor metals. For subjects of the magnitude and importance of some of these, staff and equipment have in several instances been provided on a considerable scale, and a growing number of monographs and communications to the literature issues from the respective boards.

The Coordinating Board for Chemistry, like the similar boards for other sciences, was founded for the purpose of securing interchange of information among government technical establishments, seeing that outside interests are informed, when this is practicable, and arranging for researches not otherwise provided for. The board carries out these duties in consultation with representatives of the Fighting Services and of other government departments materially affected, and with independent chemists, when departmental schemes of work are reviewed in the light of information that may be in the possession of any of the members of the board. To this board are referred questions of wider importance than are within the purview of any one department, and it keeps under its consideration the development of the natural resources of the country. With further facilities for undertaking investigations, it will be in the position to extend such work and to arrange for subjects not otherwise provided for, as well as for those at present under investigation.

General Research

Apart from the indirect help afforded to the universities by means of government grants, direct assistance is given by the Department of Scientific and Industrial Research to research workers who may be students or independent workers, and to important pieces of pure research. To these grants no conditions are attached; they are given for the extension of knowledge.

One of the objects of these grants is to encourage the supply of highly trained scientific research workers to meet the growing needs of the government, the industries of the country, and indeed of the empire. The lack of such was felt acutely during the war, although now, for chemists with the usual qualification at any rate, the conditions have changed.

Students are given grants on the recommendation of their professor that they are a type likely to be greatly benefited by spending two years at research work after taking their degree. In this case the award is for promise and not for achievement, and the hope is entertained that the necessity for these grants will gradually disappear when university finance is on a sounder basis.

Grants are given to independent workers who have shown their capacity for research, and who are handicapped by lack of facilities which they may not be able to secure from private or other sources. Further, in the case of work of unusual importance, very substantial financial assistance may be given when it appears desirable.

In this way comes recognition of the national importance of the highest type of scientific work, and to this, of course, no conditions are imposed as to the lines on which it should be carried out.

The state's appeal to chemistry has developed through the gradual recognition of the need for the application of that science to matters relating to its preservation, its currency, its financial support, its health, its food supply, its industries and finally to academic science.

In the course of this development, advantage has

been taken, if sometimes tardily, of the general advance in chemical knowledge, and frequent recourse has been had to the advice of well-known chemists of the day, and collectively of the Royal Society; thus for various purposes the following chemists, as officials or consultants, have in the past afforded assistance in the solution of specific problems referred to them, or by taking part in commissions: Boyle, Newton, Davy, Faraday, Daniell, Graham, Hofmann, Redwood, Abel, Roberts-Austen, Percy, Dupré, Playfair, Frankland, Ramsay and Dewar. It has happened in several instances that as a result of these commissions and references to chemists some definite chemical activity of the state has emerged.

It will be convenient in this summary to review the state's chemical activities before, during and after the war.

Before the War

Defence: For its defence, establishments for the production of explosives were early maintained, and when this ultimately took the form of a chemical manufacture the government factory took the lead in devising efficient processes, while from the various state research establishments has issued during the last fifty years an important body of original contributions to the theory of explosives and to the knowledge of their properties.

Metallurgy: The metallurgical progress of the country has always been a concern of the state by reason of its application to defence by land and sea, and close touch has been maintained with successive developments in the manufacture and use of cast-iron, wrought iron, steel and non-ferrous alloys. While the main advances in process have been made in the great iron and steel works, material contributions to knowledge in this sphere have been made by chemists in the government service.

Revenue: For its revenue, imposts were applied in early times, but with great uncertainty, until the charge was put on a scientific basis. Very accurate tables for the strength of alcohol were worked out under the supervision of the Royal Society at the end of the eighteenth century, to be superseded by revised ones issued only a few years ago, when, in addition, new tables were issued also by the Government Laboratory for determining the gravity of worts before fermentation. The question of rendering alcohol unpotable, but still useful for industrial purposes, has occupied much attention. As some misapprehension still exists as to the availability of alcohol for industrial purposes, a statement has been included in which the main facilities are indicated. It was on account of the necessity for safeguarding the revenue that the Government Laboratory was primarily erected, although it now performs chemical work for all state departments.

Health: The three main steps with regard to public health and sanitation in this period were the forcing of these questions into prominence by Playfair, with the consequent commissions and legislation leading to the formation of the Local Government Board and its successor, the Ministry of Health, which has many varied activities in preserving purity of air and water and protecting the workman in dangerous trades; secondly, the determination of standards for a safe water supply by the pioneering work of Frankland; and thirdly, the appointment of public analysts by the local authorities, with the Government Laboratory as referee, for safeguarding the supply of food.

Agriculture: Science was being applied to agriculture about the end of the eighteenth century, and at the beginning of the next Davy did pioneering chemical work for the Board of Agriculture. Private endeavor is responsible for the next development, state action being limited to the prevention of fraud in the sale of fertilizers and feeding stuffs. In 1909, however, the annual allocation of a sum of money to the Development Commission for the advancement of agriculture stimulated research in a large number of institutions engaged in the scientific study of problems in which chemistry plays an important part.

Other Activities: In addition to the chemical work reviewed in the foregoing sections, there is a variety of subjects connected with state departments to which chemists have contributed, such as the composition of the sea, and the composition and physical chemistry of rocks and building-stone. At the Government Laboratory a large number of investigations have been conducted on matters directly referred from government departments.

During the War

In all the activities described the war requisitioned the work of the chemist, but, naturally, predominantly to meet the demands of active warfare.

Defence: The attention that had been bestowed on the subject of propellants enabled expansion to take place with no important alteration in the technique of their manufacture, to which was adapted a new type of cordite, ultimately made on the largest scale, without using an imported solvent. For high explosives we were in much worse case, as these had not been made by the government, and were manufactured in Great Britain only in small quantity. Their study at Woolwich led to a rapid evolution of new processes, substances and methods of use. Thus a method was worked out for the manufacture of trinitrotoluene, and to save this substance a new high explosive, amatol, devised. This explosive, consisting of ammonium nitrate and trinitrotoluene, passed exhaustive trials and was ultimately produced at the rate of 4,000 tons a week. The production of

the ammonium nitrate for the mixture was in itself a stupendous undertaking, and the methods of filling the explosive into shell and other munitions gave rise to much ingenuity. In the Research Department, Woolwich, the number of qualified chemists engaged in the study of explosives in all their aspects ultimately exceeded a hundred, while for manufacture and inspection over a thousand were employed. The ideal set before himself by Lord Moulton in 1914, to produce nothing less than the maximum of explosives of which the country was capable, was realized, and they assumed a quality and character that caused them to be copied by our Allies and in reliability proved themselves superior to those of the enemy.

Starting unprepared, and without the advantage of a well-developed fine-chemical industry, we were able ultimately to make a reply in the field of chemical warfare that was rapidly becoming more and more effective; at the same time, by study and often self-sacrificing experiment, protecting the soldier by the development of very efficient respirators. In this connection and in that of explosives nearly every professor of chemistry in the country and many from beyond the sea were engaged.

Metallurgy: The enormous demand for metals for munitions and countless other war requirements led to an unprecedented concentration of the metallurgical industries on the needs of the state, and to an equal concentration of metallurgical science on investigation devoted to improvement in quality of materials for new and special war purposes. The work of the Aircraft Production Department, aided by many metallurgists and engineers, on alloy steels, of the National Physical Laboratory on aluminium alloys and of the Metallurgical Branch of the Research Department, Woolwich, on the heat-treatment of heavy forgings and on the drawing of brass is typical of the successful effort made in every quarter. The knowledge thus gained was disseminated in the form of specifications, instructions and reports, and has had a great and permanent effect on manufacture.

Health: A committee of the Royal Society had been studying food values, and were able to afford the food controller, when he took office, valuable data bearing on the rationing of food. They had considered subjects which shortly became of much importance, such as a better recovery of flour in milling wheat. The chemical examination of the food for the army in the war, carried out by the Government Laboratory, employed a large staff of chemists. For the supply of many fine-chemical substitutes used in medicine and surgery, formerly imported from abroad, such provisional arrangements had to be made as the organization of a large number of university laboratories on a semi-manufacturing basis.

Agriculture: Effects on agriculture during the war were shortage of the usual feeding stuffs for cattle and of fertilizers. The chemists stationed at Rothamsted gave special attention to the shortage of manures and prepared instructions for the guidance of farmers; and several sources of supply of potash were exploited, including kelp, felspar and the flue-dust of furnaces. As sulphuric acid was required for explosive work, fine grinding of phosphates and basic slag was found to be more efficient than was expected. Shortage also directed the attention of chemists to the use of little known food-stuffs, especially for cattle, and the information gained as to their feeding value was important.

Other Activities: In many other activities in connection with the war chemists were directly involved, such as in affording advice on the conservation of materials, on the numerous questions arising from the operations of the War Trade Department, on the restriction of imports and exports, and on matters of contraband.

AFTER THE WAR

The magnitude of the chemical effort, it can be claimed, was a factor in winning the war which must be reckoned as of importance only second to that of the bravery of our forces in the field. But it has left a lasting mark and given to chemistry a value which, were it not for the rapidity with which the achievements of science are forgotten, ought to keep before the public its connection with almost every phase of activity.

Defence: To take our subjects in the same order, we may consider some of the effects of the energy spent on the production of munitions. The intensive study of explosives and of other chemical substances used in the war has led to a more complete knowledge of their chemistry, their physical and explosive properties and has advanced chemical theory. These advantages are not of military importance only, but are reflected in the production of trade explosives. The collected records of the Department of Explosives Supply afford examples of treatment of many problems of interest to the general chemical technologist and not only to the explosives expert.

A further benefit was reaped by chemists in every position, from the professor to the youngest graduate, coming into direct contact with manufacturing methods and thus gaining insight into the applications of their science. While it is true that the opportunity came to few of these to take part in the design of plant and primary choice of process, nevertheless the experience was a novel one, as it led them into the field of technology, and can not fail to have widened their outlook. It became apparent that there was a

shortage of a type of chemist which had been developed in Germany, skilled in the transference of the chemical process from the laboratory to the works scale in the largest enterprises. A chemist of this type is one who, besides having a sound knowledge of chemistry and physics, has had experience in the materials of construction used on the large scale and in the operation of the usual types of plant for carrying out the operations of chemical manufacture, and who is capable of working out flow-sheets illustrating the process, and operating plant with every regard to economy. The need for instruction in such subjects had been borne in on men like the late Lord Moulton, and as a direct result of the war-time experience of our deficiencies in this direction has arisen the movement for erecting chairs of chemical engineering in some of our universities. It is to be expected that from these schools, especially where the instruction is super-imposed upon a full graduate course, will emanate men who will lead the way in the application of academic science to industry.

Metallurgy: While the interest of metallurgical science in war material has fortunately fallen to a peace-time level, state participation in the support of scientific research remains far greater than before the war. In metallurgy it is exercised through the Department of Scientific and Industrial Research, with its organizations of the National Physical Laboratory and the Industrial Research Associations, as, for example, those dealing with the non-ferrous metals and with cast iron. The state also continues to maintain efficient research establishments for the Fighting Services, but it is significant that the largest of these is undertaking industrial metallurgical research on a considerable scale, for the benefit of the brass and other industries. State support and encouragement are undoubtedly powerful factors in the rapid progress now taking place in every branch of metallurgical science in this country, and there is scarcely any related industry which can fail to benefit.

Revenue: Since the war the principal matters affecting the revenue are the higher duties, which have rendered necessary a further denaturation of alcohol. Improved facilities have been granted for the use of alcohol for scientific purposes and in industry; regulations have been formulated for the use of power alcohol and duties have been established on imported fine chemicals and synthetic dyestuffs.

Health: The food shortage during the war called attention to the nature and quantity of our food supplies and led to further investigations being undertaken by the Department of Scientific and Industrial Research on food preservation and storage. Activity is also shown by the appointment of committees which are working on the subject of preservatives and coloring matter in food and on the pollution of rivers by sewage and trade effluents. A great field is open in the cooperation of chemistry with medicine in the discovery of substances suitable for the treatment of the numerous diseases now traced to parasites in the blood.

Agriculture: So far as fertilizers are concerned, the lack of a supply of fixed nitrogen from the air which obtained throughout the war has now been rectified, and Great Britain for the first time is no longer exceptional among the nations by neglecting to provide itself with synthetic ammonia for agriculture and for munitions. Such war-time expedients as the use of niter-cake instead of sulphuric acid for making ammonium sulphate and superphosphate and the recovery of potash from flue-dust have not survived, but there has been a gain in the further development of "synthetic farmyard manure" and the increased use of basic slag. The present activity in research in agricultural chemistry of a fundamental character is leading to a better understanding of problems of the soil and of plant and animal nutrition and can not fail to be of ultimate benefit to farming.

Organized Applied Research and Assisted General Research: Established during the war as a result of an appreciation of the contrast between the successful application of scientific method to military purposes and the want of such application to many of our manufactures, the Department of Scientific and Industrial Research has extended over a wide field. Its main activities have been sketched in the directions of state encouragement to industry to apply chemistry to its problems, of state investigation of vital problems beyond the sphere of private enterprise, and of assistance to workers in the purely academic field. In all these spheres activity is shown by the contributions to knowledge already forthcoming.

In the expansion that has occurred in the chemical sections of state departments since the war, it is interesting to note the increase in the number of chemists that are employed. As far as can be gathered, the number of chemists working in departments maintained wholly by the state is 375 for the present year, compared with 150 in 1912, while in establishments to which the state affords partial support, such as those under the Development Commission and the Research Associations, the corresponding numbers are 150 and 50. In addition, grants are made to 145 research students and to 11 independent research workers, involving a yearly sum of about £50,000.

From the foregoing account of the connection of

the departments of state in the United Kingdom with chemistry, it is possible to trace a gradual development and ultimately a change in attitude, in passing through the stages of compulsion, expediency and assistance.

From motives of security the state was compelled to give heed to chemical matters involved in its defence, such as those which appertained to munitions of war, including metals used in their manufacture; it was constrained to uphold the standard of its currency; and it was obliged to secure a revenue. As a consequence, the first chemical departments were set up in connection with these activities and from them have emanated notable additions to chemical knowledge, improvements in methods of manufacture and specifications for government requirements that have led to improved material becoming available for civilian use. Although mostly conducted with inadequate staff, the study of these questions, it can be claimed, proved of national advantage when the time of need arose.

In the next stage, the public conscience having been awakened by the pioneering work of Playfair, it appeared expedient to safeguard health by attention to sanitation, and, as the quality of food was unsatisfactory, to set up a chemical control. Although a start was made by Davy, a member of the then Board of Agriculture, progress in this subject passed to private enterprise, and a century elapsed before direct assistance was afforded to this important matter. Out of these activities come our present system of supervision over the purity of air, water and food, and also the recent progress made in the application of chemistry and physics to problems of the soil.

The last and more recent stage is in the nature of a recognition that the state is under an obligation to assist science, and in this case the science of chemistry, on which so many important industries are based. It took the war to bring home the danger that, although the record of the country as regards discovery in pure science was unrivalled, its systematic application was too often left to other countries, with the result of lamentable shortages during war and the risk of many industries being ineffective in peace. A measure of government intervention and action appeared requisite, and research became the business of a government department. Outside of the great firms which maintain progressive chemical staffs, the firms in numerous industries have been encouraged and assisted to cooperate in the betterment of their manufactures by the application of the methods of science, and from these associations and the organizations dealing with national problems begins to flow a stream of communications indicative of useful work accomplished. Nor is the foundation of it all neglected, for encouragement is given to workers in the academic field to follow out their ideas, whithersoever they may lead them, in accordance with the truth that "research in applied science might lead to reforms, but research in pure science leads to revolutions."

It is important to be able to record an advance in securing an interchange of information among government departments, and between their work and that of universities, a matter which before the war was unsatisfactory, as it was mainly personal and sporadic.

And it is a hopeful sign also that, although the knowledge and appreciation of the methods and capabilities of science are still generally wanting, there have been of late signs that these matters are coming to engage the attention of those who guide the policy of the state.

Robert Robertson

PUBLICATION OF JOURNALS IN THE FUNDAMENTAL MEDICAL SCIENCES

There appears to be a general belief that adequate publication facilities for investigators in medical science are lacking, on account of financial difficulties in the publication of the journals representing the fundamental medical sciences. The Division of Medical Sciences of the National Research Council therefore appointed a committee (C. W. Greene, D. R. Hooker and C. M. Jackson, chairman) to gather information on this subject. Questionnaires were sent to the editors of 23 American journals in this general field, and more or less complete replies were received from the following 19:

American Journal of Anatomy.
American Journal of Hygiene.
American Journal of Physical Anthropology.
American Journal of Physiology.
Anatomical Record.
Endocrinology.
Genetics.
Journal of Bacteriology.
Journal of Biological Chemistry.
Journal of Comparative Neurology.
Journal of Experimental Medicine.
Journal of Experimental Zoology.
Journal of Immunology.
Journal of Infectious Diseases.
Journal of Medical Research.
Journal of Metabolic Research.
Journal of Parasitology.
Journal of Social Hygiene.
Physiological Reviews.

The questions asked, together with a brief summary of the replies, are as follows:

The first three questions included the name of editor, name of the journal and the scientific field covered.

(4) *How is journal managed?* The replies include management by an editor or editorial board, in a variety of ways. Business management and editorial management are often separated. Ownership may be private or vested in a scientific institution or a scientific association.

(5) *Of what society or institution may it be considered an official organ?* It is the official organ of a society or institution in 13; not in 6.

(6) *Subscription price per year or volume?* The average is $5.13 per volume (range $2.50 to $7.50). In general, the lower rates are for highly subsidized journals or those with large circulation.

(7) *How many paid subscribers?* The average is 964 (range 250–3,000). Only one is above 1,800.

(8) *What special rate (if any) is allowed to society members or others?* Special rates (discount of 10 per cent. to 50 per cent.; in 1 case, of 100 per cent. to members) are allowed in 9; none in 10.

(9) *If subsidized, how and to what extent?* Subsidies are reported for 11, range from $250 to $7,500 annually (exact data not given in most cases). No subsidy to 7.

(10) *What restrictions are placed on authors as to space, illustrations, etc.?* Variable restrictions are reported in 12; none in 7.

(11) *How many manuscripts were rejected in 1923? Give chief reasons.* In 17 replies the number of papers rejected ranged from 2 to 36. In one additional journal, the number was "more than accepted." "Inferior quality" is the chief reason for rejection. "Too long" or "inappropriate in scope" are other reasons given. No reply indicates that appropriate articles are rejected for lack of space.

(12) *How many free reprints are given?* The number is 100 in 5 cases; 50 in 8; 25 in 2; and none in 4 cases.

(13) *Do you personally believe reprints desirable?* Yes in 15 cases; no in 3.

(14) *Do reprints benefit or injure your journal subscription list? Why?* Six believe they help, largely by advertising; 3 think they injure; 10 can see no appreciable effect.

(15) *Do authors receive an honorarium other than reprints?* All say no; one adding "not as a rule."

(16) *Where is the journal printed?* Several are printed by the Williams and Wilkins Co. (Baltimore) and the Wistar Institute (Philadelphia); the others scattering.

(17) *What is the average printing and distribution cost per page?* Ten replies were received. For these, the average cost per page for each issue is $5.94 (range $1.00 to $9.35). Dividing this by the number of copies printed gives the actual cost per page, which averages somewhat less than $0.009 (9 mills) per page. For the journal with the largest circulation (3,000), the cost is only $0.002 per page.

(18) *What is your office overhead expense per year?* (19) *What other expenses do you carry?* The combined cost of these items, as reported by 12, averages $1,445 (range $100–$4,500). Many small journals get free service.

(20) *What annual subsidy would be required to put the journal on the best efficiency basis?* Average of 17 estimates is $3,171 (range $0–$15,000). Only a few appear adequately provided for.

(21) *Do you believe an Association of Medical Scientific Journals would be advantageous? If so how?* Six say yes; 3 no; 6 doubtful. The affirmatives think costs might be reduced.

(22) *Would joint printing contracts be feasible?* Six say yes; 4 no; 7 doubtful.

(23) *Could standardization of page size, type, etc., be accomplished without detriment?* Eight say yes; 4 no; 6 doubtful.

(24) *Would it be desirable and feasible to have a Scientific Press, jointly financed or owned by the societies concerned?* Six say yes; 6 no; 6 doubtful.

(25) *Could the number of our scientific journals be reduced by broadening the scope of those remaining, without detriment to science and to financial advantage?* Five say yes; 10 no; 3 doubtful. The negatives urge that the tendency to specialization promotes the advancement of science.

(26) *Additional suggestions or comment.* Some of the more striking comments are: "Better support of high class periodicals is the most pressing current need of the biological sciences." "A serious effort should be made to publish only material of unquestioned scientific value." "Subject-matter might be better distributed among the various journals." "The standardization of human creative effort is undesirable."

The committee makes no recommendations upon the questions under consideration, but believes that the data above presented may be of general interest.

C. M. JACKSON
NATIONAL RESEARCH COUNCIL

SCIENTIFIC EVENTS

THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY[1]

THE fifth meeting of the International Union of Pure and Applied Chemistry was held in Copenhagen on June 26, under the presidency of Sir William Pope. Sixteen countries were represented by about one hundred delegates. The American delega-

[1] From *Industrial and Engineering Chemistry.*

tion consisted of W. D. Bancroft, *chairman*, W. A. Noyes, Atherton Seidell, W. T. Taggart and J. E. Zanetti.

The delegates and ladies were officially welcomed by the mayor of Copenhagen in the great hall of the Raadhuset, and immediately afterwards a reception was held.

The council of the union met the following morning at nine o'clock, and a meeting of the assembly followed at eleven o'clock. The delegates were assigned to the various committees of the union and these began business that same afternoon. At four-thirty the committees adjourned to the National Institute for Theoretical Physics, where Professor Niels Bohr lectured on "Problems of the atomic theory." After the lecture, the delegates were shown the laboratories and particularly the exhibit of hafnium compounds and hafnium-bearing minerals. In the evening the delegates and their families had dinner at the Yacht Club of Copenhagen and were taken for a delightful steamer excursion on the Sund in the soft northern twilight which in Copenhagen lasts until nearly eleven o'clock.

Saturday was taken up by meetings of committees until three o'clock, when the delegates adjourned to the university to listen to Professor Einar Biilman lecture on "The hydroquinone electrode and its applications," and Professor I. N. Brönsted, on "Some remarks concerning the definition of acid and base." The delegates and their ladies were then taken in automobiles to the Glyptothek, one of Copenhagen's finest museums, where a reception was held by the director, Fr. Poulsen.

On Sunday there was an automobile excursion to the famous castle of Elsinore, lunch at "Marienlyst," a summer resort near Copenhagen, and a visit to the castle of Friedriksborg, formerly a royal residence but now a National Museum.

Monday morning was given to committee meetings. In the afternoon the delegates visited the Carlsberg breweries and listened to Professor S. P. L. Sörensen, who lectured on "The solubility of proteins." Director Vagn Jacobsen gave a talk on the brewery and in the evening entertained the delegates at dinner.

Committee meetings were held on Tuesday morning, and in the afternoon the council met to receive the reports of the committees. A meeting of the assembly followed, at which the decisions of the council were duly ratified and a vote of thanks was passed to the Danish Chemical Society for the excellent arrangements and splendid entertainment of the delegates. The fifth meeting closed with a banquet given by the Danish Chemical Society at "Den Kongelige Skydebane."

The next meeting will be held at Bucharest in June, 1925, at the invitation of the Chemical Society of Roumania.

Of the decisions taken by the council, those relating to the finances of the union are of general interest. The council voted that the funds of the union are to be kept on a gold basis in a bank accepting such deposits, in order to avoid embarrassment to the union resulting from fluctuations of exchange rates. It voted also that, beginning with 1925, the quotas of the various member countries shall be paid on a gold franc basis.

The admission of the Union of South Africa, Chile and Esthonia was unanimously voted. A resolution to recommend to the International Research Council that its statutes be so amended as to permit any country which has become a member of the League of Nations to become also a member of the International Research Council and of its unions was brought up at the last meeting of the council of the union, but as many of the delegates had not had the opportunity to discuss it with the governments and organizations they represented, no vote could be taken. It was agreed that this resolution be placed on the agenda for 1925 and that the International Research Council be informed that such a resolution would be voted on by the union at its meeting in Bucharest, in order that no time be wasted in transmission from the union to the International Research Council.

It is worthy of note that, although Sweden is not a member of the union, the Danish Chemical Society unofficially invited the Swedish chemists to attend the meeting and several representatives were present. Sir William Pope, in the name of the council, invited these representatives to attend and take part in all committee meetings.

The arrangements made by the Danes worked with perfect smoothness. While the delegates were working the ladies were taken on sightseeing tours, lunches and teas, which gave them a much-appreciated insight into Danish social life. Every one left the meeting with expressions of admiration, not only for the efficiency with which the plans were carried out, but for their hosts' charming hospitality.

SCIENTIFIC NOTES AND NEWS

Professor Horace Lamb, lately professor of mathematics at the University of Manchester, has been elected president of the British Association for the Advancement of Science for the meeting to be held next year in Southampton, England.

Dr. J. C. Fields, professor of mathematics at the University of Toronto and president of the Royal Canadian Institute, has been elected president of the International Mathematical Congress.

The American Astronomical Society, meeting at Dartmouth College, has elected Dr. A. S. Eddington, professor of astronomy at the University of Cambridge, an honorary member.

In recognition of his attainments in chemistry, the American Institute of Chemists has elected to honorary fellowship Professor Charles E. Munroe, chairman of the committee on explosives investigations of the National Research Council and professor emeritus of chemistry at the George Washington University. This is the second time that this honor has been given to an American chemist, the first recipient being Professor C. F. Chandler, of Columbia University.

Dr. Maximilian Toch, who has been giving a series of lectures at the National Institute of Technology, Peking, has had conferred upon him the title of honorary professor of industrial chemistry.

Professor Giovanni-Battista DeToni, of the University of Modena, has been elected a corresponding member of the botanical section of the French Academy of Sciences, to take the place of the late professor J. E. B. Warming, of the University of Copenhagen.

The town of Bethlehem, Pa., has acquired Sand Island, a tract of ten acres of waste land along the Monocacy meadows, which is to be improved and made into a public park and playground. It is to be named Franklin Park, in honor of Dr. William S. Franklin, for eighteen years professor of physics at Lehigh University and, since 1917, professor of physics at the Massachusetts Institute of Technology.

Dr. Camillo Golgi, emeritus professor of histology at the University of Pavia, has celebrated his seventieth birthday.

Dr. Adolph Lorenz, professor of orthopedic surgery at the University of Vienna, on the occasion of his seventieth birthday was elected an honorary member of the Society of Swedish Physicians and of the Norwegian Orthopedic Society.

Dr. H. J. H. Fenton, of the department of chemistry of the University of Cambridge, has retired after fifty years of service.

Dr. Ellwood Hendrick, of Arthur D. Little, Inc., will become head of the Chandler Chemical Museum of Columbia University on October 1.

Dr. Burton T. Simpson, pathologist at the State Institute for the Study of Malignant Diseases at Buffalo, has been appointed director in succession to the late Dr. Harvey Gaylord.

F. L. Mickle, bacteriologist at the New York Agricultural Experiment Station, has been appointed director of the Bureau of Laboratories of the Connecticut State Department of Health.

Dr. Caroline Rumbold, of the United States Department of Agriculture, formerly in the office of Sugar Plant Investigations, Washington, D. C., is now in the office of Forest Pathology at Madison, Wisconsin.

Dr. Theodore Wertenthin, instructor in organic chemistry at the University of Texas, has accepted a position as research chemist with the Solar Refining Company, Ohio.

G. St. J. Perrott, associate physical chemist, Department of the Interior, on the staff of the Bureau of Mines, has been detailed to go to Pachuca, Mexico, where he will spend approximately two months observing methods employed in the use of liquid oxygen explosives in a silver-lead mine of the Compania de Real del Monte y Pachuca.

C. A. Hogentogler, of the U. S. Bureau of Public Roads, has been granted leave of absence in order to conduct for the advisory board on highway research of the National Research Council a fact-finding survey of the economic value of reinforcement in concrete pavements. This survey is to be national in scope, and will be conducted in cooperation with agencies interested in the subject. It is proposed to cover the various soils, traffic and climatic conditions throughout the United States.

Professor E. L. Overholser, of the division of pomology of the University of California, has recently returned to Berkeley from the Fourth International Congress of Refrigeration, held in London from June 16 to 28, inclusive, where he jointly represented the University of California and the Pacific States Cold Storage and Warehousemen's Association, with headquarters in San Francisco.

Dr. Hugh S. Taylor, professor of physical chemistry at Princeton University, has departed on a six months' leave of absence in Europe, during which time he will visit laboratories and industries in England, France, Germany and the Scandinavian countries.

After spending six years as professor of silviculture and forest management at the Pennsylvania State Forest School, George S. Perry has received a year's leave of absence which he will spend in north and central Europe traveling and studying forestry science and methods, especially as regards silviculture.

Dr. F. L. Stevens, professor of plant pathology at the University of Illinois, with Mrs. Stevens, has left for a six months' collecting trip in South America. They will visit Panama, Equador, Peru, Bolivia, Chili, Argentine and Brazil, returning to take up university work in February.

Dr. Vilhjalmur Stefansson has returned from his exploration of Central Australia, and on August 15 sailed for the United States.

Professor U. S. Grant, of the department of geology of Northwestern University, and Professor John T. Stark, with eighteen students, left Ely, Minnesota, on August 13, in birch bark canoes on

what is said to be the first outdoor camping geological course ever offered by any college or university. The course is open only to students who have studied geology for a year and a half and regular credit is given.

Professor N. V. Rashevsky, of Prague, delivered two lectures on certain aspects of the theory of relativity, on August 7 and 8, at the Washington Square Laboratory of New York University.

A monument erected to the memory of J. Henri Fabre, the well-known French naturalist, at Saint-Leons, his native town, was unveiled on August 3.

Representatives of the American Meteorological Society attending the meeting of the British Association in Toronto, have planned a fund in memory of the late Dr. C. LeRoy Meisinger, which is to provide scholarships for students, who will take training for a special aerological career or for other research work in connection with the science of the air.

Dr. John J. Stevenson, professor emeritus of geology at New York University and formerly president of the Geological Society of America, died on August 10, aged eighty-two years.

Dr. George Arthur Pierson, professor emeritus of anatomy, histology and embryology at the University of Pennsylvania, died on August 7, at the age of sixty-eight years.

Professor Heinrich Precht, who was closely associated with the German potash industry and contributed many important investigations in this field, has died at the age of seventy-two years.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of the late J. C. White, former Lord Mayor of Belfast, Queen's University has received £60,000. Of this amount the sum of £40,000 is to be used in founding a professorship of biochemistry and in equipping the department.

H. H. Cushman has given a fund for the establishment of a graduate fellowship in chemical research at Western Reserve University, carrying $750 each term.

At Vanderbilt University the following appointments to the medical faculty have been made to take effect in 1925: Dr. Glenn E. Cullen, associate professor of research medicine at the University of Pennsylvania, has been appointed professor of biological chemistry; Dr. Ernest W. Goodpasture, director of the Singer Memorial Laboratory at Pittsburgh, has been appointed professor of pathology; Dr. Robert Sidney Cunningham, associate professor of anatomy at the Johns Hopkins Medical School, has been appointed professor of anatomy; Dr. James M. Neill, assistant at the Rockefeller Institute, has been appointed associate professor of bacteriology. During the present year Drs. Cullen and Goodpasture will study in Europe and Dr. Neill will study in this country with grants awarded them by the General Education Board, New York, while Dr. Cunningham will continue his work at the Johns Hopkins University.

Dr. W. J. Huff, of the Koppers Company, Pittsburgh, has been appointed professor of gas engineering at the Johns Hopkins University, to give a new course in gas engineering which is sponsored by the Southern Gas Association.

At McGill University psychology has been made a department separate from philosophy. Dr. William D. Tait has been promoted from associate professor to be chairman of the department and director of the psychological laboratory. Dr. James W. Bridges, associate professor of psychology at the University of Toronto, has accepted a call to a similar position at McGill University.

We have been requested to state that Professor A. F. Kidder has not resigned from the College of Agriculture of the Louisiana State University as has been printed elsewhere.

Sir Gilbert T. Walker, formerly director-general of Indian observatories, has been appointed professor of meteorology at the Imperial College of Science and Technology at South Kensington, in succession to Sir Napier Shaw, who is retiring.

Dr. Richard Willstatter has resigned his professorship of chemistry at Munich, on account of anti-semitic demonstrations. He has since accepted the chair of chemistry at Heidelberg.

DISCUSSION AND CORRESPONDENCE

SPECIES OF CREPIS

An unfortunate mistake in identity of a certain species of Crepis has gotten into the literature and seems likely to cause much confusion unless corrected. In his first paper on the chromosomes of Crepis, Rosenberg[1] described certain irregularities in chromosome distribution in a species designated as *Crepis Reuteriana*. In his second paper the author[2] uses the same name in referring to his original data.

1 Rosenberg, O. "Chromosomenzahlen und Chromosomendimensionen in der Gattung Crepis." *Ark. för Bot.*, Vol. 15, 1918.

2 "Weitere Untersuchungen über die Chromosomenverhältnisse in Crepis." *Svensk Bot. Tidskr.*, Vol. 14, 1920.

Upon request Professor Rosenberg kindly sent the writer seeds of his *C. "Reuteriana"* in 1921. These achenes were identical with those of *C. capillaris* (L.) Wallr. (= *C. virens*), and a large number of plants grown from this seed were all *C. capillaris*. The diploid chromosome number for *C. capillaris* is 6. Inasmuch as the normal diploid number for the plants designated by Rosenberg as *C. Reuteriana* is also 6 and plants grown from the same lot of seed were *C. capillaris*, there can be no doubt that *C. Reuteriana*, as used by Rosenberg, was a misnomer. The responsibility for this error seems to rest primarily with the Copenhagen Botanic Garden, whence Dr. Rosenberg obtained the material in question under the name, *Crepis Reuteriana*. As the determinations of this botanic garden are usually very accurate, Dr. Rosenberg assumed that the material in question was correctly labeled. This case illustrates how important it is that cytologists be very particular as to the identity of the material on which they publish. This is more apparent now than it was only a few years ago, on account of the bearing of recent cytologic, genetic and taxonomic research on phylogeny and evolution.

The chromosome number of *C. Reuteriana* has not yet been determined.

More recent references to Rosenberg's *C. "Reuteriana,"* for example by Heilborn,[3] and the probability that the true *C. Reuteriana* will figure in later investigations, make it desirable that this error in nomenclature be corrected without delay.

The writer has had the privilege of showing this note to Professor Rosenberg, who approves its publication.

E. B. Babcock

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GERMANIC PSEUDO-SCIENCE

I desire to comment very briefly on a pretentious looking publication received recently entitled, "Pflanzenverbreitung und Entwicklung der Kontinente." The author is Edgar Irmscher and the article, which runs to 235 pages and 33 figures, is published by the Institut für allgemeine Botanik, of Hamburg.

The author concludes that the present distribution and the past history of plants can best be explained by the so-called Wegener hypothesis of peripatetic continents and wandering poles. He displays the same ignorance of geological history as does Wegener, but it is not my purpose to waste space in an analysis of his conclusions, which, however, seem to me to be entirely contrary to the facts.

What is serious in its effect on the progress of science and on true scientific method is that a man can get publication for erroneous statements about which he knows nothing, as, for example (p. 70), that the core of Potosi Mountain in Bolivia is not rhyolite, but conglomerate, slate and tuff; that the Concepcion-Arauco flora of the coal measures of southern Chile is Pleistocene in age (p. 81), when actually it is interbedded and overlain with an extensive lower Miocene marine fauna; that the fossil flora from near Tumbez in northwestern Peru is Pliocene in age (p. 67), when it is interbedded with an extensive lower Miocene marine fauna that can be most conclusively correlated with the Miocene of Central America and the Antilles. Much more of a similar sort might be cited.

The fundamental basis for useful scientific speculation is that it shall explain observed facts, or at least that the speculator shall endeavor to substantiate his conclusions by facts of observation, not that facts of observation shall be misrepresented to fit the demands of a subjective hypothesis.

Edward W. Berry

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SCIENTIFIC BOOKS

A Text-book of General Physiology for Colleges. By Philip H. Mitchell. McGraw-Hill Book Co. 748 + xix pages.

Teachers of college physiology have for a number of years felt the need of a text-book suitable for elementary students, one which would present the more modern developments of the subject with less detail and from a more general point of view than any of the numerous existing works for medical students. Philip H. Mitchell's "Text-book of General Physiology" has been written to meet this need, and the cordial reception which it has received since its publication several months ago indicates that it is likely to fill successfully its intended place.

The book, in the words of its author, "is designed for use by college students who have studied introductory biology, chemistry and physics, but have not studied the organic and physical chemistry that seem prerequisite to the intelligent use of the advanced text-books of physiology and biochemistry which are now available." It is evident that there are several possible ways of attempting to meet the needs of this class of students. At the one extreme would be a text-book of "General Physiology" in the sense in which most readers of the *Journal of General Physiology* and of the writings of Bayliss understand this term. Such a book might use illustrations from the

[3] Heilborn, O., "Chromosome numbers and dimensions, species formation and phylogeny in the genus Carex." *Hereditas*, Vol. V, 1924, pp. 183–4.

physiology of man and the mammals where they were particularly appropriate, but would, for the most part, be concerned rather with general principles applicable to all forms of life than with the physiology of any single group of organisms. At the other extreme would be a text-book of human physiology of the usual sort. The author has chosen to avoid these two extremes and to follow a middle course by including as much as possible of both sides of the subject. This policy, while it has certain obvious advantages, has necessarily resulted in some loss of detail in the treatment of many individual topics.

Approximately the first third of the book is devoted to such subjects as: the food of plants and animals; proteins, fats and carbohydrates; the behavior of electrolytes; H and OH ions; vitamins; enzymes; and the physico-chemical structure of protoplasm. A considerable degree of condensation has been necessary to keep this part of the book within the limits assigned to it by the author. Thus, colloids are treated more or less incidentally under proteins, surface tension and cell permeability under fats, osmotic pressure under electrolytes, the rate of chemical reactions under H and OH ions, etc.

The remainder of the book gives a sufficiently complete account of human physiology to make it a suitable text for college students whose interests are primarily in this field. The chapter headings of this part of the book are: "Excitation and inhibition," "Physiology of contraction," "The functional units of nervous systems," "Reflexes," "The correlating action of the nervous system," "Receptors," "Digestion," "Chemistry of blood and lymph," "The circulation of the blood," "Respiration," "Physiological oxidations and heat regulation," "Excretion," "Protein metabolism," "Amounts of food required by animals," and "Internal secretions." In the treatment of these subjects, while the general point of view has not been entirely abandoned, the chief emphasis has been placed upon and most of the illustrative material drawn from the field of mammalian physiology.

The book is written in a clear and interesting style, and typographical errors are relatively few. It is perhaps inevitable that a work which covers such a wide field should in its first edition contain a number of statements which are either inaccurate or misleading. As examples, may be mentioned the following: "This coefficient for chemical reactions is always equal to or greater than 2 for an interval of 10°C." (p. 275), "another advantage of subdivision is the increase of surface tension thus obtained," etc. (p. 236); "This is further confirmed by the smallness of the part of the blood CO_2 which may be removed by the vacuum pump without adding acid to break down the bicarbonates of the blood" (p. 566). The author has also at times shown a certain carelessness in his use of physical terms, as, for example, on p. 140, where he speaks of a force of 22.4 atmospheres, and on p. 326, where the statement occurs that "this work is sufficient to raise a weight about nine times as great as that of its own body"—the distance through which the weight is lifted being unspecified. However, such defects as these can readily be eliminated, and they doubtless will be in the second edition which the work deserves and is likely to have. On the whole, the author is to be congratulated on having produced a book which will be of much assistance to teachers and students of college physiology as well as to general readers interested in this subject.

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RECENT CONTRIBUTIONS TO OUR KNOWLEDGE OF THE FOSSIL FISHES OF CALIFORNIA

The present note is written for the purpose of calling attention to certain recent discoveries, by David Starr Jordan and associates, through which the remarkable fish faunas of the Miocene and other beds of California are being disclosed.

Dr. Jordan's earlier contributions[1] in this field (and also his two latest papers[2]) dealt largely with the teeth of sharks. A number of interesting fishes of other groups were, however, described. Among these may be mentioned a crossopterygian scale and a remarkable jaw-bone named *Xenesthes velox,* in which the outer surface seems to be covered with denticles, both assigned to the Triassic; a new type related to the pholidophorids, namely *Etringus,* and another new genus *Rogenio,* from the Soledad formation (probably pre-Miocene); a fossil *Gasterosteus,* and finally a series of Quaternary remains of a sturgeon, from the deposits of Potter Creek Cave, and of salmons and suckers from Oregon lake beds.

[1] Jordan, David Starr. "The fossil fishes of California with supplementary notes on other species of extinct fishes," Univ. Cal. Publ. Geol., 5, 1907, pp. 95–144, pls. 11, 12. "Note on a fossil stickleback fish from Nevada," Smiths. Misc. Publ., 52, 1908, p. 117. Jordan, David Starr, and Carl Hugh Beal. "Supplementary notes on fossil sharks," Univ. Cal. Publ. Geol., 7, 1913, pp. 243–256.

[2] Jordan, David Starr. "Some sharks' teeth from the California Pliocene," *Am. Jour. Sci.,* 3, 1922, pp. 338–342, figs. 1–3. Jordan, David Starr, and Harold Hannibal. "Fossil sharks and rays of the Pacific slope of North America," Bull. Sou. Cal. Acad. Sci., 22, 1923, pp. 27–68, many figures.

In 1919 the fishes of the supposedly pre-Miocene Soledad deposits were treated at greater length.[3] *Etringus, Rogenio* and allied forms were discussed, along with the new genus of primitive scombroids, *Auxides,* and a little fish called *Bulbiceps.* The last was referred to the liparids (later doubtfully transferred to the gobiesocids), but the distorted imprint shows no decisive character.

At the same time Jordan, in co-authorship with J. Z. Gilbert—who already had described a fossil flounder from the same beds[4]—published a first account of the truly remarkable teleost fauna of the California Miocene.[5] Although a few of the genera represented, as *Ganolytes* and *Rogenio,* were referred to older (Soledad) types, the majority of the remains were found to be related to fishes living in present, usually Californian, seas. An atherinid genus, *Zanteclites,* was regarded as related to the Melanotaeniinae of Australian fresh waters; it was discussed at greater length in a subsequent paper.[6] The fact that a number of the forms have a high number of vertebrae suggested the hypothesis that the seas in which these fishes lived were cool.

The Pliocene fishes were discussed in a separate, briefer report.[7] Two new genera were described from imperfect remains: *Ectasis,* very dubiously a gonorhynchid (perhaps an elopid), and *Arnoldites,* apparently a gadid.

The Miocene fishes of the richest horizon yet uncovered in North America, namely, the diatom beds of Lompoc, were again described by Jordan and Gilbert in 1920.[8] In this paper a number of new generic types were diagnosed, and the large series of scombroids found in these beds reviewed. In a supplementary paper,[9] the remains first regarded as a flounder were shown through more complete examples to represent the remarkable oceanic fish, *Lampris.* This discovery was of particular interest in demonstrating the antiquity of this peculiar type.

A popular account of those Miocene fishes followed.[10] In this, the simultaneous destruction of about twelve hundred million individuals of a herring-like species (*Xyne grex*) was recounted.

Subsequently, the Tertiary fish fauna of California was again revised, the paper being illustrated with numerous restorations.[11] "The purpose of this paper is to make old bones live again." The dermal structures, which of course were largely unpreserved, were drawn from the supposedly nearest living relatives.

In this paper Jordan advanced a series of very interesting and important generalizations regarding the fauna.[12] He concluded that:

> The present fauna of California is derived from that of the Miocene period with a slight admixture from the northward and from Japan. The Tertiary fauna of California is nearly all included in families still extant on the coast. All the species are distinct from their living allies, and most of them must be placed in different genera.
>
> The most striking difference which appears thus far is that we have found no trace among the fossils of the viviparous surf-fish (Embiotocidae) which form so conspicuous a part of the existing fauna.
>
> Among the fossil fishes actually known we have none which suggests any affinity with Asiatic forms. Most of them are distinctly characteristic of California, a few only belonging to types now wanting in that region, but represented in the Gulf of Mexico, and in one or two cases in the Mediterranean. In Miocene times, the present Isthmus of Panama was an open channel.
>
> No species, either distinctly tropical or distinctly subarctic, appear among the Tertiary fishes of southern California. We must, therefore, conclude that the Miocene temperature differed little from that which obtains at present.
>
> It is evident from the absence, partial or complete, of silt or other rain-washed material in the deposits containing the fishes, that the climate was arid.

It is a matter of high regret that many of the fish remains of these diatom shales are so poorly pre-

[3] Jordan, David Starr. "Fossil fishes of southern California. I. Fossil fishes of the Soledad Deposits," Stanford Univ. Publ., Univ. Ser., 1919, pp. 3–12.

[4] Gilbert, James Zaccheus. "Evesthes jordani, a primitive flounder from the Miocene of California," Univ. Cal Publ., Geol., 5, 1910, pp. 405–411, pls. 41–42.

[5] Jordan, David Starr, and James Zaccheus Gilbert, "Fossil fishes of southern California. II. Fossil fishes of the Miocene (Monterey) formations," Stanford Univ. Publ., Univ. Ser., 1919, pp. 13–60.

[6] Jordan, David Starr, and Carl Leavitt Hubbs. "Studies in ichthyology. A monographic review of the family of Atherinidae or Silversides," Stanford Univ. Publ., Univ. Ser., 1919, pp. 1–87, pls. 1–12 (*Zanteclites* described on pp. 10–12, and figures on pl. 11).

[7] Jordan, David Starr, and James Zaccheus Gilbert. "Fossil fishes of southern California. III. Fossil fishes of the Pliocene formations," Stanford Univ. Publ., Univ. Ser., 1919, pp. 61–64.

[8] Jordan, David Starr, and James Zaccheus Gilbert. "Fossil fishes of diatom beds of Lompoc, California," Stanford Univ. Publ., Univ. Ser., 1920, pp. 1–45, pls. 1–29.

[9] Jordan, David Starr. "An ancient moonfish," *The Scientific Monthly,* 2, 1920, pp. 470–473, figs. 1–3.

[10] Jordan, David Starr. "A Miocene catastrophe," *Natural History,* 20, 1920, pp. 18 ff. (reprinted in *The Guide to Nature,* 13, 1921, pp. 132 ff.).

[11] Jordan, David Starr. "The fish fauna of the California Tertiary," Stanford Univ. Publ., Biol. Ser., 1, 1921, pp. 233–300, pls. 1–57.

[12] These generalizations were repeated in another paper, "The Miocene shore-fishes of California," *The Scientific Monthly,* Nov., 1921, pp. 459–463, 4 figs.

served. Sometimes little but the imprint of the fossil remains, and even this is usually much distorted, particularly in the head region. This being the case, the identifications must be based on the general proportions and on the relationships of superficial parts to a greater degree than on osteological details. Dr. Jordan's extremely wide knowledge of modern fishes must, therefore, have been almost indispensable in the work he has done. Despite this advantage, however, the relationships of a considerable number of the forms described could not be definitely determined. Occasionally, the estimate of kinship was widely altered in subsequent papers. For example, a fish first regarded as a herring was (from better material) later referred to the Synentognathi, while a supposed labrid was later shown to represent a clupeid. It must be noted, however, that in the later papers a greater attention to the skeletal features which are yet apparent—particularly the interneurals and interhaemals, as related to one another and to the fin rays—has added an increased definiteness to the identification and the determination of relationships.

The reviewer feels constrained to express his opinion that throughout the work (as in so many treatises on fossil fishes) too many imperfect and incomplete impressions were considered. To name and to attempt the classification of fossil remains of clearly indeterminate relationship can hardly serve to advance our knowledge of extinct faunas. In the case under review, a close study of the best preserved remains of these Tertiary fishes (some show exquisite detail) would in his opinion have yielded the same generalizations, and would have added stability to the nomenclature, and prevented the intrusion into the work of certain elements of unnecessary doubt.

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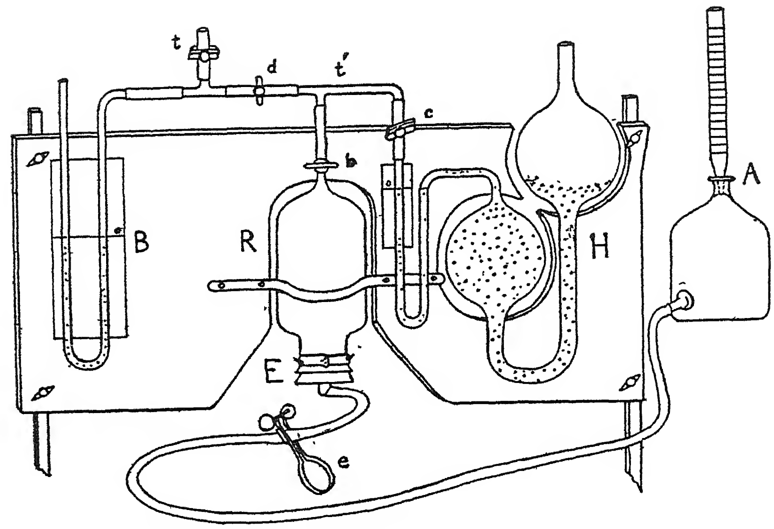
LABORATORY APPARATUS AND METHODS

RESPIRATORY EXCHANGE OF THE FROG

Three years ago the writer began using a very simple class demonstration to show the change in volume imposed upon respired air during the respiratory exchange of the frog in its winter or early spring condition. A short metal tube was soldered over a hole made in the lid of a one-pint Mason fruit jar. A frog was placed in the jar and the jar-lid was screwed down air tight. About three minutes were allowed for the changing volume of air in the jar, occasioned by the slightly warmer body of the frog, to reach equilibrium, and then, by a suitable rubber tube, the metal tube of the jar-lid was connected with a water manometer. The frog was allowed to breathe the air in the jar for one hour to one and one half hours, during which time the water in the manometer arms gradually changed level several centimeters in such direction as to show a decrease in volume of the air in the jar. The frog appeared to experience no special discomfort in breathing the confined air for that length of time.

This year the thought occurred that this experiment might be easily modified and extended so as to afford a very good method (for class use) of determining the respiratory quotient of the frog. The apparatus now used is represented in the accompanying figure. It consists of the following glass parts: a water manometer, *B*; two heavy T-tubes of small bore, *t* and *t'*; a special respiration chamber, *R*, of 250 cc capacity; an elbow-tube through a rubber stopper, *E*; a special Hempel gas absorption pipette, *H*, of 250 cc capacity, and an ordinary aspirating bottle, *A*, of 250 cc capacity having a Mohr burette (25 cc graduated to 1/10 cc) inserted through a rubber stopper in its top in such manner that, as water rises from the aspirating bottle into the burette, air can not be trapped beneath the stopper. These parts are connected by rubber tubing as illustrated. The neck of the respiration chamber at *E* has an opening of 45 mm in diameter and takes a No. 10 rubber stopper. A metal collar around this neck of the chamber bears two hooks over which a pliable wire may be tightly looped to hold the stopper in exact place during the experiment. The chamber may be closed above with a glass stop cock, *b*. At *c*, *d* and *t* are screw pinch cocks, and at *e* is a Mohr's pinch cock. A solution of one part of KOH to two parts of water is used in the Hempel pipette. The aspirating bottle with its burette and its tubing is filled with pure water. It was found that acidulated water (HCl) may not be used. Even when the acid used is weak enough to seem not especially irritating to the skin of the frog, it nevertheless appears to be absorbed by the skin so that CO_2 is liberated from the alkaline carbonates of the blood. Thus the volume of the gas in the respiration chamber slowly but constantly increases until the frog dies.

When an experiment is to be started, the apparatus (as described) and the frog to be used are brought into a room where the temperature is comparatively constant and kept until they are as nearly as possible the same temperature as the air of the room. Then cock, *c*, is closed and cocks *b*, *d* and *t* are opened. The frog is introduced into *R* and the stopper *E*, is fastened securely in place with care not to place the hand on *R* so as to change its temperature. Cock, *e*, is opened to pass just enough water into *R* to cover the stopper, *E*, and seal it. Under these conditions, the manometer will read level



Apparatus used for showing the change in volume of air respired by a frog, and for determining the R. Q.

at atmospheric pressure. Cock, *t,* is now closed. For two or three minutes, thereafter, it will usually be observed that the outer limb of the manometer rises, indicating that the volume of the air with the frog is increasing a little. This appears to be due to the frog's body being very slightly warmer than the air. The volume ceases to increase within about two minutes, as a rule; then *t* is momentarily opened and closed again to restore the manometer to zero at atmospheric pressure, and the experiment begins. Gradually the manometer will show that the volume of the air with the frog is slowly decreasing. The best results are obtained, with a respiration chamber of this size, by terminating the experiment in 20 to 25 minutes, depending somewhat on the activity of the frog. It seems best in other words not to allow the difference reading of the manometer arms to exceed eight or nine centimeters. The reason for this will be pointed out in a moment. When the respiration period is to be terminated, the burette of *A* is read, then cock, *e,* is opened to allow the passage of just enough water into *R* to restore the zero level of the manometer. The burette of *A* is again read. Cock, *d,* is now closed, and *c* is opened. The bottle, *A,* is raised and cock, *e,* is opened. Water flows into *R* until most of the respired air is driven into the KOH pipette. The air is then returned to *R,* by lowering *A,* for a moment. This operation is repeated three times—all the air being sent into *H* the third time—care being used that no water is driven beyond *b* and that no KOH is drawn beyond *c.* When the water goes over the frog's head, he promptly stops lung breathing, and suffers no ill effects, until the air is returned from the Hempel pipette. As the air is returned the last time, the KOH solution is carefully stopped just as it rises to the zero point of the Hempel absorption pipette. Cock, *c,* is then closed and cock, *d,* is opened. The aspirating bottle, *A,* and cock, *e,* are now manipulated, if necessary, until the manometer stands at zero. The burette of *A* is read again. The manipulation for CO_2 absorption should occupy four or five minutes. Even then the manometer level will be apt to change at first in such direction as to show a slight increase in the volume of the air with the frog, but this should not make a difference of more than 0.2 cc in the final reading of the burette at *A*. During the course of the experiment, the percentage of CO_2 in the air confined in the respiration chamber gradually increases until slightly abnormal amounts of CO_2 begin to be retained in the blood of the frog. This CO_2 is given off by the frog comparatively rapidly after the CO_2-free air from the Hempel pipette is returned to the respiration chamber, hence the necessity of returning the air three times. However, if the respiration period has been continued for an hour or so (too long, for a chamber of this size), the abnormal accumulation of CO_2 in the frog will be so great as to require considerable time for it to be given up—thus too greatly prolonging the time used in absorbing CO_2.

Let n equal the first reading of burette, *A,* with the manometer level at atmospheric pressure.

Let m equal the second reading of burette, *A,* at the end of the respiration period, after the manometer is restored to the zero level.

Then the difference $(m - n)$ equals the volume of the oxygen taken up by the frog, less the volume of the carbon dioxide given off in respiration.

Let p equal the reading of burette, *A,* after CO_2 absorption in the Hempel pipette.

Then $p - m$ equals the volume of CO_2 given off in respiration.

$p - m + (m - n)$ equals $p - n$ equals the volume of oxygen retained by the frog during the respiration period.

R. Q. equals $\frac{CO_2}{O_2}$ equals $\frac{p - m}{p - n}$

A series of nine experiments carried out in the manner described on the same frog gave the following values for the respiratory quotient: 0.71; 0.72; 0.76; 0.80; 0.65; 0.69; 0.72; 0.70; 0.78. Of course the method has its obvious limitations as to accuracy and must not be urged, in that respect, in comparison with those methods which permit the animal to breathe fresh air throughout the experiment and also allow the respiration period to be terminated on an exact moment. Nevertheless, the results obtained are fairly uniform and the method does afford some advantages as a laboratory experiment for illustrating the facts involved in the respiratory exchange. The manometer visibly impresses the student with the fact that in case of an animal oxidizing protein and fat the volume of the oxygen used in respiration is greater than the volume of the carbon dioxide given off. The experiment may be carried out in a comparatively short time and the operation is simple—only one absorbent fluid being necessary. A "cold blooded" animal is made use of, so that the temperature of the respired air is so slightly above that of the surrounding air as not to interfere with the immediate volumetric work, as may be the case when a mammal is used.

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LABELING MICROSCOPE SLIDES

THE method developed by the writer of preparing labels for microscope slides has been used sufficiently by the departments of plant pathology and botany at the University of Wisconsin to warrant the hope that it will prove of value to others.

In the preparation of a large number of, or even a few, microscope slides for class use satisfactory labeling of the finished slides is often an important problem. Printed labels are expensive, while printing or writing even a few duplicate labels is both time-consuming and irksome, and requires unusual skill for satisfactory results.

The method herein described produces in any quantity neat, accurate labels in the form of photographic prints the exact size of a standard slide label and gummed ready for use. In addition the process is simple, rapid and inexpensive, and requires very little special equipment.

The original copy from which the negative is made may be drawn to any scale, preferably two or three times the desired size. The standard slide label is fifteen sixteenths of an inch square. A piece of white bristol board or drawing paper is ruled with a 3H pencil into squares of three times the linear dimensions of the slide label. As a matter of economy of time and materials 12 or 24 different labels are prepared at one time on a single large sheet of paper. Twelve labels arranged in three rows of four each can be photographed on a 4 x 5 plate, leaving about one half inch margin all around for convenience in handling. Similarly, 24 labels in four rows of six each will go on a 5 x 7 plate.

The data are now lettered in the squares in pencil, using penciled guide lines which may be ruled for the entire sheet at one time. After having been checked for errors, the labels are inked with black waterproof ink, using a ruling pen for straight lines and Barch-Paysant lettering pens (Keuffel and Esser Co.) for the lettering. Pens No. 4 and No. 5 are suitable for lettering a label enlarged three times (Fig. 1, A), while No. 5 and No. 6 are suitable for a label enlarged two times (Fig. 1, C). The necessity of allowing for reduction in the width of lines is emphasized by Fig. 1 in which B and D are photographic reductions of A and C. It also shows that slight imperfections in the lettering are minimized by reduction.

The completed sheet of labels is cleaned with art gum, photographed on a process plate, and developed in a contrast developer (hydroquinone). To avoid distortion of the image on the plate the center of the copy should be approximately on the optical axis of the camera lens, and perpendicular to it. The image is easily tested for size by measuring with a slide labeled on the ground glass, or for squareness, by measuring the diagonals, which should be equal in length. As many prints as are desired can now be quickly made from the negative, which may be preserved for future needs. A dull or semi-gloss printing paper is preferred by the writer to a glossy paper. Solar, a thin, matt-surfaced printing paper made by the Defender Photo Company, gives labels of practically the same thickness and surface as the commercial labels.

The adhesive is applied to the back of the prints before the labels are cut apart. An adhesive prepared from animal glue was found superior to the various commercial liquid glues tested. The following formula is a slight modification of one suggested by Mr. Wilbur Jones, of the Forest Products Laboratory, Madison, Wisconsin. A good grade of animal glue, which comes in small flakes, is dissolved in twice its weight of water in a water bath. When the glue is thoroughly dissolved, ten per cent. of glycerine (by volume) is added to make it flexible when dry, and one half per cent. of betanaphthol as a

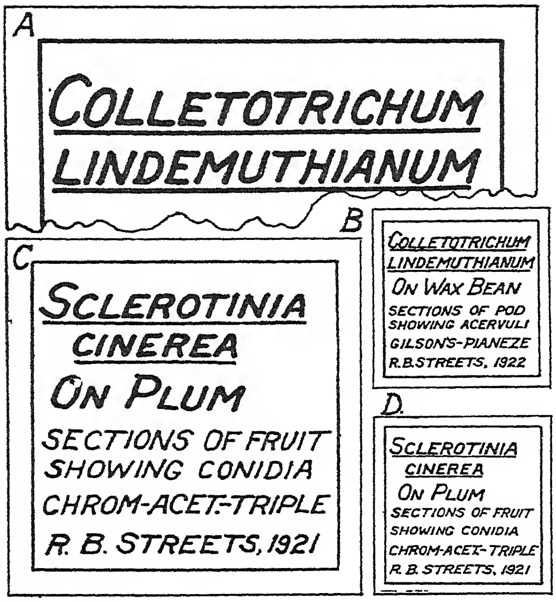

FIG. 1. Figures showing scale to which originals (A and C) are drawn to produce finished microscope slide labels (B and D) by photographic reduction. A is drawn three times size of finished label B; C is drawn twice size of D. Either scale can be used with good results.

preservative. This adhesive is a firm jell at room temperatures, but of the consistency of mucilage when heated to 60° C. in a water bath.

The adhesive is applied to the back of the prints in an even layer using a small flat brush. To facilitate a quick, even coating of the prints they should be placed upon a warm surface (an electric slide warmer is very satisfactory). The adhesive dries in about fifteen minutes, and the labels may be cut apart along the penciled guide lines. A trimming board gives very straight even margins. Both printed and gummed surfaces of the labels are fully equal to the commercial product in permanence either before or after they have been moistened and rubbed into good contact with the slides.

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SPECIAL ARTICLES

A GENETIC LINKAGE BETWEEN SIZE AND COLOR FACTORS IN THE TOMATO[1]

GENETIC factors responsible for size characters are notoriously elusive, and their actual presence in the germinal complex is largely hypothetical. They can not be isolated singly and studied as units, a mode of procedure that has led to some tangible results in the case of equally complex factors for qualitative characters. One of the most direct methods of actually proving the existence of definite size (quantitative) factors is that of linking them with the well-known system of chromosomal factors in any species. Such a method should give proof of the genetic similarity of the two types of genes.

In a large series of crosses between commercial varieties of tomatoes, involving various sizes (weights) and colors of the fruit, a definite linkage between these two types of genetic factors has been established. Color in tomato fruits is mainly determined by two different pairs of genes. One pair, *Rr*, controls the red and yellow flesh color, the former being dominant. The other pair, *Yy*, determines skin color, *Y* producing a yellow pigment in the cell walls of the epidermis of the fruit, and *y* giving a colorless condition in these cells which is recessive in inheritance. Size of fruit in tomatoes is perhaps best interpreted by the multiple factor hypothesis.

Crosses involving these two pairs of color genes and different sizes of the fruit were made reciprocally. The F_2 generations and reciprocal crosses of the F_1 plants with pure varieties of the double recessive color phase (*rr yy*), were grown with extraordinary precautions as to uniformity of treatment, replication, etc. Measurements for each plant were taken of average weight of fruit, time of flowering, two diameters of the fruit, and number of seed locules. In every case, the P_1, F_1, F_2 and backcrosses under consideration were grown during the same season.

One series of crosses and backcrosses has given some very outstanding results. In this case, the parents were the varieties Red Cherry (*RR YY*, mean fruit weight 7.3 ± 0.3 grams) and Golden Beauty (rr yy, mean fruit weight 166.5 ± 6.4 grams). The F_1 of this cross and its reciprocal, grown the same season as the P_1 and F_2 generations, had a mean fruit weight of 23.9 ± 0.4 grams indicating a noticeable dominance of the smaller fruit type. This F_1 was crossed back to the pure Golden Beauty parent and also to an unrelated variety, Yellow Peach (*rr yy*).

The F_2 data, with respect to color of fruit, showed the di-hybrid distribution of four color classes, *RY*, *Ry*, *rY* and *ry*. The mean weight of fruit in grams for these four kinds of fruits was as follows:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	*y*	*Y*	*y*
F_2 means—	22.0 ± 0.7	37.3 ± 1.8	21.9 ± 1.4	46.6 ± 5.6
Differences—	15.3 ± 1.9		24.7 ± 5.8	

It is perfectly obvious that the types with colorless skin (*y*) are consistently heavier than those with

[1] Paper No. 4, Department of Genetics, Iowa State College, Ames, Iowa.

the yellow (Y) skin, whether the fruits are red or yellow in flesh color. In other words, there is a significant tendency for the F_2 fruits to vary towards the parental types as regards both skin color and weight, since the large parent (Golden Beauty) contributed the y factor, and the smaller parent (Red Cherry) the Y factor. The differences noted above are statistically significant, because the one between the two sorts of red fruits is 8 times its probable error, and the other difference is 4.3 times its probable error.

Verification for this relation between skin color and weight factors was afforded by two series of backcrosses of the same F_1 plant used to produce the F_2. In the backcross to the pure Golden Beauty parent, the same four color types appeared in the progenies, but in approximately equal numbers. The mean weights (in grams) for the four colors of this backcross and its reciprocal are as follows:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	y	Y	y
Backcross to G. B. parent	50.4 ± 2.9	84.1 ± 4.5	52.6 ± 2.3	75.3 ± 3.2
Differences—	33.7 ± 5.3		22.7 ± 3.9	

Here, likewise, the tendency for the y type of fruit to be heavier than the Y class is apparent. Among both the red and yellow fruits, the differences in weight between the skin color classes are statistically significant, being approximately 6 times their respective probable errors of the difference.

Another backcross to the same F_1 plant gives further evidence. In this case the Yellow Peach variety was used reciprocally on the F_1 of Red Cherry × Golden Beauty with the following results:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	y	Y	y
Backcross to Y. P. Variety	28.5 ± 0.9	45.3 ± 1.6	31.1 ± 1.3	41.0 ± 1.7
Differences—	16.8 ± 1.8		9.9 ± 2.1	

When it is recalled that the Yellow Peach variety used in this backcross was in no way related to the parents or F_1, it becomes evident that the situation is perhaps general and not specific for the particular varieties of the cross.

Accordingly, the evidence from three distinct sources admits of the same conclusion that the color factor pair Yy is closely linked with genetic factors for weight of fruit. On the modern theory of inheritance the same chromosome that carries y in the Golden Beauty variety also bears a major factor for a greater weight of fruit.

It is interesting to note that red and yellow flesh color, dependent on genes R and r, seem to be independent of weight. This is true not only for the varieties noted above, but also for a large series of crosses involving the well-known varieties, Bonny Best and Yellow Cherry. The details of these crosses are reserved for a future report when larger progenies will be available so that small differences might be detected and checked biometrically.

It might be added that the number of seed locules also exhibits a linkage with the Yy color factors but to a somewhat lessened degree. This is to be expected, however, since weight and number of locules in the F_2 generation show a high correlation ($r = .6056 \pm .0427$). The same general relation exists between Yy and time of flowering, although in this case the correlation between weight and time of flowering is not very high, r having a value of $.2799 \pm .0622$. These evidences of a linkage between the color genes Yy, and both time of flowering and number of seed locules merely afford other sources of verification for the situation proved with respect to weight of fruit.

A final proof for the general situation rests with a cross between a small variety with colorless skin and a larger variety with yellow skin, the reverse of the Golden Beauty × Red Cherry cross. If the *small* size of fruit is then found to be linked with the y color factor, the case is complete. Such a cross has been made, involving the Yellow Peach and Bonny Best varieties, but at least two generations of plants are still required to obtain the adequate data. Meanwhile, it is hoped that other investigators may test this linkage with different varieties of tomatoes under other conditions. It opens a fertile field of research for testing the fundamental relation between genetic linkages involving quantitative characters and those correlations so conveniently studied by multiple correlation methods with their path coefficients and coefficients of determination.

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THE ELECTROMAGNETIC NATURE OF COLLOIDAL, ENZYME AND CATALYTIC ACTION AND ITS SIGNIFICANCE

It is well known that when a colloidal solution of platinum is mixed with a solution of peroxide of hydrogen, there occurs an evolution of oxygen gas, set free from the peroxide of hydrogen molecule.

If, instead of mixing these two solutions, the peroxide of hydrogen solution is put in a fermentation tube, and in a test tube is put a solution of colloidal platinum, and the two solutions are then connected by an electrical conductor, such as a copper, iron or preferably a platinum wire, there

occurs a well-marked evolution of gas in the fermentation tube.

If there is inserted in this conducting line the primary coil of an induction coil, and if from one pole of the secondary induction circuit a metallic conductor is run to another fermentation tube filled with peroxide of hydrogen, an evolution of oxygen gas occurs which is much greater than in fermentation tubes connected with the primary coil or in those connected directly with the colloidal solution without the intervention of an induction coil.

Such a simple experiment may suggest interesting interpretations and result in far-reaching consequences.

As there has been no mixing of the two solutions there has been no "direct" chemical action.

As there has been no metallic circuit there can have been no galvanic current with its electrolytic effect. Yet the effect which has been transmitted over the wire must be an electrical one of some sort.

It is well known that a constant, direct, uninterrupted electrical current has no inductive effect; and yet in the experiment cited a well-marked inductive action is shown.

It would seem, then, that the electrical effect passing through the metallic conductor must be an interrupted or oscillating one.

This experiment may be repeated successfully with a variety of colloidal substances, such as colloidal solutions of ferric hydroxide, nickel hydroxide and albumen in dilute sodium carbonate solution.

A marked effect is obtained when a .01 per cent. solution of freshly prepared unprotected colloidal platinum in equal parts of a .3 per cent. sodium carbonate solution is used.

When small detached pieces of platinum, copper or iron wire are immersed in peroxide of hydrogen solution, there is a slow evolution of gas, but when such controls are used it is found that the evolution of gas in the experimental tubes—especially those connected with the secondary induction coil—is far more copious.

Potassium permanganate solutions, although not colloidal, seem to have a somewhat similar effect in releasing oxygen from the hydrogen peroxide solution when the latter is connected with the secondary induction coil.

That enzymes have a similar action is shown by the following experiment:

In a test tube is placed some pancreatin in a .3 per cent. solution of sodium carbonate. A wire is run from this solution, through the induction coil, to a fermentation tube containing peroxide of hydrogen solution. In the tube connected with the secondary coil there is a copious evolution of gas.

The following experiment bears upon pancreatic digestion of proteids:

In a beaker is placed some pancreatin in a .3 per cent. solution of sodium carbonate. During the course of the experiment, fresh solution is used from time to time. Electrodes, immersed in this solution, are connected with the primary coil of an induction coil. From the primary and secondary coils are run wires terminating in electrodes immersed in beakers containing solutions of egg albumen in .3 per cent. sodium carbonate solution. Bacterial action is adequately prevented and a similar albumen solution, not connected with this series, is used as a control. After three months the appearance of peptone was detected in the two experimental solutions—most markedly in the solution connected with the secondary induction coil, while the control albumen solution showed no peptone.

We have here, then, the process of pancreatic digestion by an enzyme, pancreatin, which can have occurred only through the agency of an interrupted or oscillating electrical action or electrical vibrations.

That the action of enzymes or zymogens may be "vibrational" in character is suggested by an experiment reported by Green (Fermentation—page 413).

"By exposing the zymogen of saliva to red rays of the spectrum its activity is increased 53 per cent., while its action is diminished 15 per cent. by exposure to the green rays."

Such an effect is very suggestive of "sympathetic" vibration or resonance on the part of the zymogenic molecule toward the red rays, and an interference toward the green rays.

The specific action of enzymes is well known. If, then, their action is due to electromagnetic wave vibrations, their specificity must depend upon their production of a definite wave length—different for each enzyme.

The similarity of action of colloids, enzymes, catalyzers and anti-toxins has long been recognized.

Ehrlich's theory of the specificity of anti-toxin action implied the analogy of the fitting of a key to a lock. It may be found, however, that the specificity of anti-toxin action is dependent upon their possession of a definite electromagnetic wave length.

If such processes of digestion and antitoxin activity are controlled by electromagnetic wave vibrations, similar forms of control may be found to influence the processes of growth and reproduction and other metabolic phenomena.

Such consequences are of the most far-reaching importance, and will fully justify further inquiry along the lines here suggested.

NORMAN E. DITMAN
NEW YORK, N. Y.

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CONTENTS

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PROGRESS AND PROSPECTS IN CHEMOTHERAPY[1]

IN the mind of every physiologist visiting Toronto to-day one recent advance in our science will certainly be uppermost. We rejoice with our colleagues here in a great achievement which has opened new vistas of knowledge to exploration, has brought relief to unmeasured misery, and has turned the eyes of a world, too often careless of such things, in proper gratitude and well-founded hope to this university and its medical school. Insulin, and its still marvelous and mysterious action, have held a prominent place in the interest of many of us, myself included, during the past year or two. In one of our meetings, however, we shall have the opportunity of considering the observations and opinions of many who are now working on its properties and their significance, and among them will be some who were associated with its discovery. I have thought it appropriate, therefore, to ask your attention to-day to some recent developments in a widely different field of investigation. The subject which I have chosen presents points of general physiological and biochemical interest, apart from its immediately practical importance for the treatment of disease. It has, further, in one way, a special appropriateness to this year's meeting of the British Association. For our knowledge of an important group of diseases, caused by the parasitic trypanosomes, which have provided the experimental material for a very large proportion of chemotherapeutic investigations, we are in the largest measure indebted to the pioneer work of the distinguished president of the association, Sir David Bruce.

THE THEORETICAL ORIGIN OF CHEMOTHERAPY

Chemotherapy may be defined as the specific treatment of infections by artificial remedies. The object of those who study it is to find new remedies which will cure or arrest diseases due to infections, not by alleviating the symptoms or invigorating the patient, but by directly and specifically suppressing the infection. Chemotherapy, in this wide sense, is not entirely of recent growth. When the natives of Peru discovered the value in fevers of the cinchona bark, which the Jesuits brought to Europe in the 17th century, they had found a specific remedy for malaria, which is still the best available. Similarly the natives of Brazil had found in ipecacuanha, which reached

[1] From the address of the president of the Section of Physiology of the British Association for the Advancement of Science, Toronto, August, 1924.

Europe shortly after cinchona, a remedy for amoebic dysentery better than any other which our modern systematic and scientific efforts have produced. Modern chemistry, indeed, has separated the alkaloids from these drugs, and has made it possible to identify among them the actively therapeutic constituents; protozoology has revealed the nature of the infections. We know now that cinchona owes its curative action chiefly to quinine and quinidine, and that they act as specific exterminators of the malaria parasites, and not simply as remedies for fevers in general; and we know that ipecacuanha owes its action to emetine and cepheline, and that these act as exterminators of the entamoeba causing tropical dysentery, and not simply as symptomatic remedies for dysenteries of any kind. But chemistry has produced no better remedy for malaria than quinine, or for amoebic dysentery than emetine; and the method by which either of these alkaloids cuts short the infection by a particular parasite, the nature of its specific action, remains a fascinating problem.

The modern development of chemotherapy, as a new department in therapeutic science, claiming the cooperation of parasitologists, microbiologists and synthetic chemists, did not take origin, however, simply from the study of these traditional remedies. It may be regarded rather as an outcome of the study of the natural antibodies. The investigation of these natural antagonists to infection produced a new therapeutic ideal. Not only had they shown themselves to have an intensely specific affinity for the infecting organism of the toxin which caused their production; they were also perfectly harmless to the patient, behaving, in relation to his organism, as normal constituents of his body fluids and tissues. Ehrlich aptly compared them to magic bullets, constrained by a charm to fly straight to their specific objective, and to turn aside from anything else in their path.

Of the artificial remedies, on the other hand, which man had empirically discovered, even of drugs like those just mentioned as being specific for certain infections, the best that could be hoped was that they would eliminate the parasite before they poisoned the patient. And thus, when the limitations of natural immunity were becoming clearer; when it was realized that to certain forms of infection, several of which had proved to be infections by protozoa, the body was unable to produce antibodies of sufficient potency to eliminate the infection and leave the patient immune; the question arose whether, with the new and growing powers afforded by synthetic chemistry, man could not so far rival nature's achievements as to produce in the laboratory substances specifically adapted to unite with and kill the protoplasm of these parasites, as the natural antibodies united with that of others, and to leave the tissues of the patient similarly unaffected. The ideal of this new and systematic chemotherapy, as the imaginative genius of Paul Ehrlich conceived it, was to be the production by synthesis of substances with a powerful specific affinity for and a consequent toxic action on the protoplasm of the parasites, and none for that of the host—of substances, to use Ehrlich's own terminology, which should be maximally parasitotropic and minimally organotropic.

I want to invite your attention to-day to the results which during the last twenty years have been produced under the stimulus of this bold conception; not, indeed, to attempt a survey or summary of all that has been done, but, in the light of a few of the suggestive facts which have emerged, to consider how far this hypothesis has justified itself, and whether it can be accepted as a safe guide to future progress, as it has undoubtedly provided the initiative and working basis for much of what has been accomplished hitherto. Before we deal with some of the actual results obtained, it may be well to consider a little more closely what Ehrlich's working hypothesis involved. The problem was to discover, by chemical synthesis, a compound which, in virtue of its chemical structure, should have a maximal affinity for the protoplasm of a microscopic parasite, such as a trypanosome, and a minimal affinity for that of the host's body cells. These affinities were pictured by Ehrlich, in the terms of his side-chain theory, as determined by certain side-chains of the complex protein molecule, or chemoreceptors, which endowed the protoplasm with specific combining properties. When it is remembered that knowledge of the chemistry of the protoplasm of a trypanosome is almost nil, and that what little we do know suggests that it is very similar to that of our own cells, it will be admitted that the enterprise was one calling for scientific courage and imagination in the highest degree. Complete failure would not have been surprising; the matter for surprise, and for admiration, is that so large a measure of practical success should, at the end of two decades, already claim record.

Trypanosomes and Spirochetes

The Action of Dyes and Analogous Compounds

The investigations leading, in the last few years, to a clear promise, at last, of the successful treatment of the diseases in man and animals due to infections with trypanosomes, had at least two different starting-points, the action of dyes and the action of arsenic. Ehrlich's early interest in the synthetic dyes and his observations of the curiously selective distribution which they often exhibited among the cells and tissues of the body naturally suggested the possibility of finding in this group a substance which would selectively fix itself to the parasite and poison its protoplasm without injuring that of the host. The tech-

nique developed by Laveran and Mesnil, by which a particular strain of trypanosomes could be passed through a series of mice or rats, and produce an infection of standardized type and virulence, enabled the effect of a large selection of dyes to be investigated, with the view of finding one which would favorably influence the infection. A starting-point having been obtained, the resources of synthetic dye production were available to produce an indefinitely long series of derivatives and modifications of the active compound, each to be tested in its turn. In this way Ehrlich and Shiga arrived at a substance which gave experimental promise of curative value, a benzidine dye to which the name "Trypan red" was given.

Two years later, Mesnil and Nicolle, proceeding further along the same path, described an even more favorably active blue toluidine dye, "Trypan blue." This is the only one of the dyes which has hitherto had a genuine practical success in the treatment of a protozoal infection, not indeed by a trypanosome, but by an intracorpuscular parasite of the genus Piroplasma, which infects dogs and cattle. This successful application of Trypan blue to an animal disease has a special interest for us to-day, in that it resulted from the joint labors of last year's president of this section, Professor Nuttall, with a Canadian collaborator, Dr. Hadwen.

We may turn aside at this point to inquire how far the results even of these earlier investigations corresponded with the theory which gave them their impetus. Did these dyes really act by selectively staining and killing the parasites, and leaving the host's cells untouched? The evidence was certainly not in favor of such a view. Ehrlich and Shiga themselves observed that Trypan red, even in relatively high concentrations, was practically innocuous to the trypanosomes outside the body. The trypanosomes, like other cells, were not stained by the dye until they died, and there was no clear evidence that they died sooner in the Trypan-red solution than in ordinary saline. Again, Trypan red cured an infection by the trypanosome of "Mal de Caderas" (*T. equinum*) in the mouse, but not the same infection transferred to the guinea-pig, rat or dog; nor did it cure an infection with the trypanosome of Nagana (*T. brucei*) in mice. Now, to explain such a difference by stating that the affinity of Trypan red for *Trypanosoma equinum* was much higher than its affinity for the tissues of the mouse, but not than its affinity for those of the rat, would be merely to restate, in terms of the theory, the observed fact that the mouse was cured while the rat was not; and the lack of direct affinity for the dye shown by trypanosomes outside the body made such an interpretation in any case unsatisfactory. One point, however, appeared very significant, and it is met repeatedly in studying the action of effectively chemotherapeutic substances, namely, that the trypanosomes treated with the dye *in vitro*, though neither obviously stained nor visibly harmed, had lost their power of infection, and died out promptly if introduced into the body of a mouse. Under such conditions only minimal traces of the dye are introduced into the animal, and we are left with a series of alternative possibilities. It is possible that sufficient dye has been taken up by the trypanosomes to kill them eventually, the period of survival *in vitro* being inadequate to display its action; or that Trypan red is converted by the influence of the body fluids and tissues into something which is effectively lethal for the parasite; or, again, that the effect of the drug is not directly to kill the trypanosomes, but, leaving their individual vitality and motility unimpaired, so to modify them that they have lost the power of rapidly reproducing themselves and invading the fluids and tissues of the mouse's body—in other words, have lost that complex of adjustments to the various factors of the host's natural resistance which we crudely summarize as "virulence." Such possibilities involve either storage or modification of the dye by the host's tissues or their essential cooperation in its curative effect.

One other active dye must be mentioned as providing the link with a recent, most important advance. Mesnil and Nicolle in 1906 made some promising experiments with a dye, Afridol violet, which differed from any previously tested in that its central nucleus was diamino-diphenyl-urea. From this time onwards there was no further public indication of progress along these lines until 1920, when Händel and Joetten published the results obtained with a remarkable substance which, as the result of some fifteen years of continuous work by their scientific staff, had been introduced by the great dye and chemical firm of Bayer. This substance, which is not a dye, but the colorless, water-soluble salt of a complex sulphonic acid, has hitherto been known as Bayer "205," and, for reasons which need not concern us, the firm decided not to publish its formula. To students of their patent specifications, however, it seemed pretty certain that it would prove to be one of a long series of compounds, formed of chains of aminobenzoyl radicles, united by amide linkages, with a central urea linkage, like the dye last mentioned, and terminal naphthylamine sulphonic acid groupings. A number of these substances, having no diazo-linkages, were not dyes, but there was no indication as to which constitution, out of an immense number possible, would prove to be that of the remarkable substance numbered "205." There is a reasonable probability that its identity has now been settled by the recent work of Fourneau and his coworkers in the Pasteur Insti-

tute, who made and investigated an extensive series of compounds of this general type, and found one, which they numbered "309," which conspicuously excelled all others, even those closely related to it, in the favorable ratio which it displayed between a just toxic dose and that which caused a trypanosome infection in mice to disappear. As in the case of "205," the ratio, the "chemotherapeutic index" of Ehrlich, was found by Fourneau in some experiments with his compounds to be well over 100. At least it may be said that, if M. Fourneau has not identified Bayer "205," he has discovered another compound having very similar and probably as valuable properties.

The most remarkable property of "205" is the long persistence of its effect. A dose injected into a mouse, a rabbit or a rat will not only free the animal, if already infected, from trypanosomes in a few days, but will also render it resistant to such infection for a period of weeks or even months. During that period its serum, or extracts from certain of its organs, exhibit a curative action if injected into another animal infected with trypanosomes.

Though there seems no reason to doubt that this substance has cured a number of cases of African sleeping-sickness in man, even some in which the disease was well advanced and in which all previously known remedies had failed, the mode of its action still presents a number of attractive obscurities. Like many other remedies which are experimentally efficient when injected into the infected animal, it has little or no obvious action when directly applied to trypanosomes *in vitro*. The paradox is, perhaps, less than usually significant in this case, since the action in the animal is delayed, a period of a few days elapsing before the trypanosomes begin to disappear from the blood. We might suppose that the action is too slow to be recognized during the period of survival of the parasites outside the body, or that it affects not the individual vitality of the trypanosomes, but their power of reproducing themselves. The latter idea is supported, as in other cases, by the fact that trypanosomes treated with the drug *in vitro,* or taken from an injected animal before the curative effect has become manifest, fail to infect another animal. It is contradicted, however, by the observation that the trypanosomes, just before the curative action begins, show not a depression, but a stimulation of reproductive activity, division forms becoming abnormally common. Is it that during or immediately after division the parasites become specially liable to the action of the drug? It may be so; but one thing seems perfectly clear, namely, that the action is a very complex one, involving the cooperation, in some way, of the host. For here again it is found that the curative action, on infections by the same strain of trypanosomes, varies enormously with the species infected, a mouse being cured with ease, an ox or a horse with difficulty or not at all. A curious fact is that the rapidly progressive and fatal infections produced in mice by certain pathogenic trypanosomes are easily and certainly cured, while the apparently harmless natural infection, seen in many wild rats, by *T. lewisi* is not affected at all. Then there are some curious records of treatment in man, in which the symptoms of sleeping-sickness have disappeared, but the trypanosomes are still found in the cerebro-spinal fluid, suggesting that, though the parasites have not been killed, they have lost their virulence and their power of invading the brain substance.

The features of the action of this remedy, however, which have most interest for the physiologist and the biochemist are those related to the long persistence of its effect. "205" has a large molecule, but it is extremely soluble in water and diffusible through collodion membranes. How, in such circumstances, can we explain the persistence of its sterilizing and prophylactic action for months after an injection? At first sight one is tempted to regard it as incredible that a substance with these properties should persist in the body for such a period, and to suggest that the action must be due to its stimulation of the body to form its own protective substances. This possibility, however, seems to be excluded by the fact that the serum of the protected animal does not lose its curative properties if heated. On the other hand, there have recently appeared, some of them only in preliminary abstract, a series of highly suggestive observations, indicating that "205" has properties of entering into a combination of some kind with the serum proteins. After standing for an hour or two in serum, "205" no longer passes into an ultra-filtrate through collodion, and if the proteins are coagulated by heat is not to be found in the filtrate. The proteins of the blood, moreover, are stated to lose many of their characteristic properties by entering into this combination, the blood losing its normal power of clotting and the serum proteins not being precipitated by mercury salts or tannin.

It would be both useless and presumptuous for a mere onlooker to speculate in detail on the significance, for the curative action of "205," of properties which are only now beginning to be investigated. One conclusion, however, I think we are entitled to draw. It is sufficiently evident that here is no question of a substance curing simply on account of its affinity for parasites and lack of affinity for the host's tissues. What direct action on the parasite "205" itself may possess has still to be demonstrated; we may feel reasonably certain, on the other hand, that its affinities for the constituents of the host's blood and tissues play an important part in its remarkable and peculiar curative properties.

Derivatives of Arsenic

In the case of the other series of investigations which I mentioned, that dealing with the organic derivatives of arsenic, we find again many difficulties, in the way of the simple theory, of a cure due to distribution by chemical affinities. None of the compounds of this series, which have reached practical trial and success in the treatment of spirochetal or trypanosomal infections, atoxyl, salvarsan or tryparsamide, has a directly lethal action on the parasites in dilutions at all comparable to those which can be safely and effectively produced in the body of the host. The paradox of this direct inertness of atoxyl, the starting-point of the series, seemed to be explained when Ehrlich showed that its reduction to the corresponding arsenoxide produced a substance with an intense directly lethal action on trypanosomes. Similarly, the partial oxidation of salvarsan, to the corresponding arsenoxide, produced a substance having the intensely lethal action on spirochetes or trypanosomes *in vitro,* which salvarsan itself conspicuously and paradoxically lacked. In these cases, we may make the supposition, which Voegtlin and his co-workers, especially, have recently supported by detailed evidence, that the reduction or oxidation effected by contact with the tissues is the essential preliminary to the curative action; a supposition which, it will be noted, again introduces the host as an essential participant in the cure. The fact that the administration of these relatively inactive predecessors is therapeutically more effective than the injection of the directly active oxides derived from them would then be explained on the assumption that the slow liberation of these latter in the body, at a rate which never produces a high concentration, provides the optimum condition for their persistent action on the parasites without danger to the host. This slow and persistent liberation of the directly active substance would be favored by the physical properties of salvarsan, which at the reaction of the body is practically insoluble, and must be rapidly deposited after injection.

In their recent work on the action of Tryparsamide, the compound prepared by Jacobs and Heidelberger at the Rockefeller Institute which has shared with Bayer "205" the credit of making the eventual conquest of African sleeping-sickness a hopeful possibility, Brown and Pearce find it necessary to introduce yet other considerations to explain its effects. Tested by Ehrlich's therapeutic index—the ratio between the lowest curative and the highest non-toxic dose—it gives a relatively unfavorable figure. Brown and Pearce practically abandon the attempt to account for its action on the supposition that it directly kills the parasites and attribute its value largely to its power of penetrating easily into the tissues and reinforcing there the processes of natural resistance.

Action of Bismuth

Another conception of the mode of action of these arsenical remedies, also involving a direct participation in the host's tissues, was put forward by Levaditi. He found that from atoxyl a directly parasiticidal preparation could be obtained by incubating it with an emulsion of fresh liver substance. As the first step, therefore, in the curative action of atoxyl, he postulated a combination of its reduction product with some constituent of the liver or other tissue, giving rise to the essential curative complex, which he named "trypanotoxyl." Levaditi's observations were explained by Ehrlich and Roehl as due simply to the reducing action of the liver substance on atoxyl; but it would be difficult to apply this explanation to the quite recently published observations by Levaditi and his colleagues on the mode of action of bismuth in curing spirochetal infections. A sodium potassium bismuthyl tartrate—a bismuth analogue of tartar emetic—had been found to have valuable curative properties in syphilis and other spirochetal infections. Later, various other bismuth salts, bismuth suboxide and even finely divided metallic bismuth were found to produce similar effects. According to Levaditi and Nicolau, these preparations have, by themselves, a relatively weak action, or none at all, on the spirochetes outside the body. If they are mixed, however, with a cell-free extract of liver, which is itself harmless to spirochetes, the mixture, after incubation, acquires a potent spirocheticidal action. The possibility of a mere reducing action of the liver extract seems here to be excluded, since bismuthous oxide or metallic bismuth itself yields a spirocheticidal mixture, containing Levaditi's hypothetical "bismoxyl," when incubated with the liver extract. If these observations are confirmed, there will be a strong indication that some cell-constituent enters into the composition of or is essential to the formation of the directly active substance from any of the derivatives of arsenic, antimony or bismuth, as a preliminary to its action on an infection due to a trypanosome or a spirochete. Again we have evidence of an organotropic property of the remedy, as an essential condition of its activity.

Resistant Strains of Trypanosomes

In the phenomena of the acquisition of resistance, by a strain of infecting trypanosomes to a particular curative drug, discovered and largely worked out in Ehrlich's laboratory, we meet again with facts which can only with the greatest difficulty be reconciled with the assumption that the drug directly attacks the parasites. It was found, for example, that if a mouse infected with trypanosomes received an incompletely effective series of doses of atoxyl, the trypanosomes appearing in the blood at each relapse were more

and more resistant to the drug, unitl they could not be caused to disappear by any dose of atoxyl which the mouse would tolerate. The strain, having once acquired this resistance, would retain it, on passage through an indefinitely long series of mice, without further treatment. Mesnil and Brimont, however, made the remarkable observation that, if the strain of trypanosomes was transferred to a rat, it immediately became in that animal susceptible again to treatment with atoxyl, remained so as long as it was kept in rats, to reacquire its old resistance to atoxyl as soon as it was retransferred to mice. Such a fact seems to be not at all explicable on the theory that the directly active agent, to which the trypanosome becomes resistant, is a mere reduction product of atoxyl; it is much more easily reconciled with a mechanism such as that described by Levaditi, in which a constituent of the host's tissues enters into the formation of the trypanocidal substance. We can imagine the trypanosome becoming immune to Levaditi's mouse-trypanotoxyl, and remaining susceptible to the corresponding rat-product.

The whole question of this acquired resistance of the parasites to the action of curative drugs bristles with points of difficulty and interest. Ehrlich attributed the sensitiveness of the parasite, for a particular curative agent, to the possession by its protoplasmic molecule of a special form of side chain, or "chemoreceptor," which determined its affinity for that agent. When the trypanosome became resistant, it was simple to suppose that it did so by losing the appropriate chemoreceptors; an atoxyl-resistant trypanosome, for example, had lost its atoxyl receptors. Apart from the objections already mentioned, this conception met a new difficulty, when in Ehrlich's laboratory it was found that the resistance was by no means as rigidly specific as it had first appeared to be. Not only imperfect treatment with atoxyl, but treatment with a particular group of dyes, having no kind of chemical relation to it, was found to produce a race of trypanosomes resistant to atoxyl and to other arsenical derivatives. To suggest that the chemoreceptors for arsenic and for these dyes are identical is merely to restate the fact of this reciprocal action in terms having no definite meaning. Obviously no more precise conception as to its significance can be formed until we know something more of the conditions on which resistance and susceptibility depend. A recent suggestion by Voegtlin has interest in making, at least, an attempt at interpretation in more definite biochemical terms. Voegtlin and his coworkers point out that arsenious oxide and its derivatives readily combine with substances containing a sulphydrile grouping and find that the toxic action of the organic arsenoxides on trypanosome and mammal alike is depressed by the simultaneous injection of excess of various sulphydrile compounds.

Suggested Reaction of an Arsenoxide with a Sulphydrile Compound

The work of Hopkins, showing the importance of one such sulphydrile compound, reduced glutathione, in the hydrolytic oxidation-reduction processes of the cell, suggests to Voegtlin that a combination with such groups and consequent suppression of this vital function may explain the toxic and curative actions of the arsenical derivatives and that a formation by the trypanosome of the sulphydrile compound, in excess of its vital need, may be the basis of acquired resistance. If certain dyes similarly affect this cellular oxidation system, the production under their influence of strains of trypanosomes resistant to arsenic would also be explained. So stated the suggestion leaves many aspects of the problem still unconsidered; but it may at least be allowed the merit of an attempt to interpret the action of these drugs in terms of known biochemical facts.

Conclusion

We have considered but a few examples of the directions in which chemotherapeutic investigation has proved practically fruitful, including some in which it shows, at the moment, the most hopeful signs of progress. If one considers any one group of investigations by itself, one may easily feel, at the same time, elated by the practical success obtained, in the cure of some infection which, but a few years ago, seemed beyond the reach of treatment, and depressed by the disharmony between the results of experiment and the theoretical conceptions, hitherto available, of the nature of the chemotherapeutic process. Some of the most notable practical triumphs in this field have resulted not from experimental investigations based on theory but from an almost empirical trial on human patients suffering from one type of infection of a remedy which had experimentally shown promising results in infections of a different and sometimes of a widely different type. The partial success of tartar emetic in trypanosome infections might have justified a hope that it would have some effect in kala-azar but hardly a prediction of its really remarkable efficacy in that previously intractable form of infection. Still less would it have justified expectation of the brilliant success of this same drug in infections by the Schistosoma or Bilharzia-worm, which but recently seemed almost beyond the hope of any kind of treatment. With such instances in mind, one might, but a year or two ago, have been tempted to suggest that the attempts at theoretical investigation of the intimate mechanism of the chemotherapeutic process had contributed little to the practical achievements, and that a reasonably intelligent empiricism was still the safest guide. I do not think that the suggestion would even then have been defensible, and it would assuredly have been stultified by the results

of the past few years. Patient, systematic exploration, by routes of which the initial sections were already mapped in the early days of chemotherapy, has in these recent years again led to results of major importance, both for practical therapeutics and for the theoretical basis of future advance. That the original theoretical framework begins to show itself inadequate for the expanding fabric is good reason for its reconstruction; but we may well beware of hasty and wholesale rejection, remembering that it served the early builders well. I think that it is especially encouraging to note that, though, in the action of almost every remedy which has proved its value in the specific cure of infection, there are features which can not be interpreted by a strict application of Ehrlich's distribution hypothesis, the discrepancies begin to show a new congruity among themselves. Repeatedly we find phenomena which point to the need of modifying the theoretical structure in the same direction. The conception of a remedy not killing the parasites immediately, but modifying their virulence, or lowering their resistance to the body's natural defences; of a remedy not acting as such, but in virtue of the formation from it in the body of some directly toxic product, either by a modification of its structure or by its union with some tissue constituent; of an affinity of the remedy for certain cells of the host's body, leading to the formation of a depot from which, in long persistent, never dangerous concentration, the curative substance is slowly released; all these conceptions present themselves, again and again, as necessary for our present rationalization of the effects observed. It can hardly be doubted that they will potently influence the methods by which, in the immediate future, new and still better specific remedies are sought. But though our practical aim, in relation to the affinities of a remedy for the parasite and for the host's tissues, may be radically changed, the meaning of these specific affinities, so delicately adjusted to a precise molecular pattern, remains dark. Ehrlich's chemoreceptors may no longer satisfy us, but we have nothing equally definite to replace them. I have endeavored to indicate what seem to me hopeful signs of new contacts between biochemistry and chemotherapy. There is promise, in another direction, that at least some aspects of the problem of immune specificity are being brought within the scope of strictly chemical investigation, as in the recent work of Avery and Heidelberger, on the constituent of a pneumococcus which combines with the specific precipitin. As in Ehrlich's pioneer work in chemotherapy, it can hardly be doubted that an increased understanding of the meaning of immune specificity, which but a short while ago might have seemed hopelessly beyond the range of attack by chemical weapons, will still influence ideas and help to shape the course of further investigations on the chemotherapeutic process. As the biological complexity of the problem is realized, it becomes increasingly a matter for wonder and admiration that so much of practical value has already been achieved—the treatment of the spirochetal infections, syphilis, yaws and relapsing fever, revolutionized; Leishmania infections, kala-azar and Baghdad boil and Bilharzia infections which crippled the health of whole populations in countries such as Egypt, now made definitely curable; trypanosome infections, such as the deadly African sleeping-sickness, after years of alternating promise and disappointments, brought now at last within the range of effective treatment. And if such results have already been attained, in a period during which practice has often and inevitably outrun theory, we may well be hopeful for a future in which fuller understanding should make for more orderly progress.

H. H. Dale

DEVONIAN PALEONTOLOGY OF BOLIVIA

No geological system in South America has been so well explored as has the Devonian. The bead-roll of eminent contributors to the elucidation of South American Devonian paleontology commences with the name of d'Orbigny in 1842 and includes longer or shorter contributions by Salter (1861), Rathbun (1874, 1878), Hartt (1875), A. Ulrich (1893), von Ammon (1893), Katzer (1896–1898), Kayser (1897, 1900), Haug (1905), Thomas (1905), Newton (1906), and Knod (1908). John M. Clarke, whose labors in this field cover nearly a quarter of a century (1890–1913), and culminated in his magnificent monograph published in 1913, in which the whole field was covered in his characteristic masterly way, has contributed more than any one else to this subject.

The eastern South American Devonian has, on the whole, received more attention and more thorough treatment than that of the Andean region, although Devonian beds outcrop for hundreds of miles along the medial extent of the Andean system. The Devonian is well represented and fairly fossiliferous in Bolivia, in which general region d'Orbigny first collected Devonian fossils in South America, but these Devonian faunas have not heretofore received the exhaustive treatment that has been devoted to those of Brazil.

Last year there appeared in the Annales de Paléontologie a monograph of the Devonian of Bolivia by Roman Kozlowski,[1] who spent six years in Bolivia, first as a professor and subsequently as director of the School of Mines at Oruro. In this work there are described 138 different forms, making the Bolivian

[1] Kozlowski, R., "Faune Dévonienne de bolivie." Ann. Paléont., tome xii, 112 pp., 10 pls., 1923.

fauna the largest known from South America, that from Paraná, for example, consisting of 73 species. This fauna comprises 33 trilobites, 9 cephalopods, 5 conularias, 7 pterapods, 15 gastropods, 26 pelecypods, 33 brachiopods, 3 echinoderms, 3 bryozoa and 4 corals. The few corals, bryozoa and crinoids; the reduced number of brachiopods, and the great abundance of pelecypods emphasize the prevailing muddy environment during Devonian time in Bolivia.

The sub-divisions of the Bolivian Devonian are geographic rather than stratigraphic, although Kozlowski believes the succession given below as probable: At the base are the shales of the Cordillera Real, as at Araca, and these are correlated with the North American Helderberg. Above this lies the Icla formation, consisting of the *Rensselaria knodi* sandstone, the Conularia shales and the Huamampampa sandstone. These are collectively correlated with the Oriskany of North America, the Maecurú sandstone of Pará, the Devonian of Paraná, Matto Grosso, the Argentina, Falkland Islands and the Bokkeveld beds of Africa.

Above the Icla formation is the Sicasica formation of the Altaplanicie, which consists of the lower fossiliferous shales, the *Homalonotus dekayi* shales and the upper barren sandstone. These are correlated with the Ereré sandstone of Pará, and with the middle Devonian of North America, and possibly extending upward into the upper Devonian.

The austral character of the Devonian faunas of South America, emphasized by Clarke, are, in Bolivia, shown chiefly by the Phacopidae. Paraná and Africa show the largest number of identical forms, and Africa has twice as many as Pará. Kozlowski is inclined to think that the barrier that prevented intercommunication between Bolivia and Pará was water too deep to permit the interchange of shallow water faunas rather than a land barrier, and this implies that such a deep water barrier was lacking at that time between South Africa and Bolivia.

Kozlowski identifies a considerable number of North American species in the Bolivian Devonian. These occur for the most part in the supposed younger Devonian Sicasica formation, and include such forms as *Homalonotus dekayi, Orthoceras constrictum, Nuculites oblongatus, Tropidoleptus carinatus, Vitulina pustulosa;* and closely related forms of Lophospira, Ambocoelia, Liorhynchus and Spirifer. From this he concludes that the means of intercommunication between North America and Bolivia were easier at that time than in the earlier Devonian. We have compared these with material in the Hopkins collections from Bolivia, and with North American specimens, and believe that such an identity is not established in all cases, but this is a question to be decided by more material and by someone better versed in Devonian paleontology than the reviewer.

Kozlowski's memoir is a most complete and scholarly contribution. His adequate and well-executed illustrations amply supply the deficient and poor illustrations of Bolivian material in the works of Ulrich and Knod. The work is a most welcome contribution to the paleontology of South America, and lays a secure basis for future studies of the Andean Devonian.

EDWARD W. BERRY
THE JOHNS HOPKINS UNIVERSITY

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PREPARATIONS FOR THE FIFTH WASHINGTON MEETING AND ASSOCIATED ORGANIZATIONS

THE local committees in charge of preparations for the approaching Washington meeting of scientists (December 29, 1924, to January 3, 1925) have been organized as follows:

The Local Committee for the Fifth Washington Meeting

William Mather Lewis, president of George Washington University, *chairman.*

C. G. Abbot, assistant secretary, Smithsonian Institution.

Gilbert H. Grosvenor, president of the National Geographic Society.

Vernon Kellogg, permanent secretary of the National Research Council.

John C. Merriam, president of the Carnegie Institution of Washington.

David White, home secretary of the National Academy of Sciences, and senior geologist, U. S. Geological Survey.

The Committee on Special Arrangements for the Fifth Washington Meeting

Walter M. Gilbert, administrative secretary, Carnegie Institution of Washington, *chairman.*

Albert L. Barrows, assistant secretary, National Research Council.

Paul Brockett, assistant secretary, National Academy of Sciences.

Austin H. Clark, curator, Division of Echinoderms, U. S. National Museum.

Hugh Miller, dean of engineering, George Washington University.

W. J. Showalter, associate editor, National Geographic Society.

Chairmen of Subcommittees

Albert L. Barrows, Hotels.

Paul Brockett, Transportation.

Austin H. Clark, Publicity.
Walter M. Gilbert, Finances.
Hugh Miller, Meeting Places.
W. J. Showalter, Exhibition.

Local Representatives for the Sections

Section A (Mathematics). Howard L. Hodgkins, George Washington University.

Section B (Physics). Lyman J. Briggs, 3208 Newark street.

Section C (Chemistry). R. S. McBride, Colorado Building.

Section D (Astronomy). W. S. Eichelberger, U. S. Naval Observatory.

Section E (Geology and Geography). W. C. Mendenhall, U. S. Geological Survey.

Section F (Zoological Sciences). Paul D. Bartsch, U. S. National Museum.

Section G (Botanical Sciences). R. F. Griggs, George Washington University.

Section H (Anthropology). J. Walter Fewkes, Smithsonian Institution.

Section I (Psychology). William C. Ruediger, George Washington University.

Section K (Social and Economic Sciences). Frederick L. Hoffman, Babson Institute, Wellesley Hills, Mass.

Section L (Historical and Philological Sciences). Frederick E. Brasch, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

Section M (Engineering). William Bowie, U. S. Coast and Geodetic Survey.

Section N (Medical Sciences). Carl Voegtlin, Hygienic Laboratory.

Section O (Agriculture). Karl F. Kellerman, Bureau of Plant Industry.

Section Q (Education). C. R. Mann, 26 Jackson Place.

The following named organizations have thus far intimated their intention to hold meetings at Washington in convocation week, in conjunction with the association. The name and address of the secretary follows the name of the organization. Organizations marked with an asterisk are officially affiliated with the association:

*American Mathematical Society. R. G. D. Richardson, Brown University, Providence, R. I.

*Mathematical Association of America. W. D. Cairns, Oberlin, Ohio.

Pi Mu Epsilon Mathematical Fraternity. E. D. Roe, Jr., 123 W. Ostrander Ave., Syracuse, N. Y.

*American Physical Society. Harold W. Webb, Columbia University, New York, N. Y.

*American Meteorological Society. Charles F. Brooks, Clark University, Worcester, Mass.

*American Astronomical Society. Joel Stebbins, Washburn Observatory, Madison, Wis.

*Association of American Geographers. Charles C. Colby, University of Chicago, Chicago, Ill.

National Council of Geography Teachers. Geo. J. Miller, Mankato, Minn.

*American Society of Zoologists. W. C. Allee, University of Chicago, Chicago, Ill.

*Entomological Society of America. Clell Lee Metcalf, University of Illinois, Urbana, Ill.

*American Association of Economic Entomologists. C. W. Collins, Melrose Highlands, Mass.

*Botanical Society of America. I. F. Lewis, University of Virginia, University, Va.

*American Phytopathological Society. R. J. Haskell, U. S. Department of Agriculture, Washington, D. C.

American Society of Plant Physiologists. R. B. Harvey, University of Minnesota, Minneapolis, Minn.

*American Society of Naturalists. A. F. Shull, University of Michigan, Ann Arbor, Mich.

*Ecological Society of America. A. O. Weese, James Millikin University, Decatur, Ill.

*American Microscopical Society. Paul S. Welch, University of Michigan, Ann Arbor, Mich.

*American Anthropological Association. A. V. Kidder, Phillips Academy, Andover, Mass.

American Folk-Lore Society. Gladys A. Reichard, Barnard College, Columbia University, New York, N. Y.

*American Psychological Association. John E. Anderson, Drawer 13, Yale Station, New Haven, Conn.

Metric Association. Howard Richards, Jr., 156 Fifth Ave., New York, N. Y.

American Physiological Society. Walter K. Meek, University of Wisconsin, Madison, Wis.

*Society of American Bacteriologists. J. M. Sherman, Cornell University, Ithaca, N. Y.

American Society for Pharmacology and Experimental Therapeutics. Edgar D. Brown, University of Minnesota, Minneapolis, Minn.

American Society of Biological Chemists. Wright Wilson, University of Pennsylvania, Philadelphia, Pa.

American Society for Experimental Pathology. E. B. Krumbhaar, Chestnut Hill, Philadelphia, Pa.

*American Society for Horticultural Science. C. P. Close, College Park, Maryland.

Association of Official Seed Analysts. A. L. Stone, University of Wisconsin, Madison, Wis.

Potato Association of America. William Stuart, U. S. Department of Agriculture, Washington, D. C.

Phi Delta Kappa Fraternity. Clayton R. Wise, 13319 E. Sixth St., E. C. Cleveland, Ohio.

*Society of Sigma Xi. Edward Ellery, Union College. Schenectady, N. Y.

*American Association of University Professors. H W. Tyler, 222 Charles River Road, Cambridge, Mass.

*Gamma Alpha Graduate Scientific Fraternity. L. M. Hutchins, U. S. Bureau of Plant Industry, Washington, D. C.

The local arrangements for sections and for associated organizations are in charge of the local section

representatives named above, who are in close touch with the Committee on Special Arrangements. Secretaries of associated organizations and of sections of the association are asked to correspond with the local representatives of their respective sections when taking up arrangements for hotel headquarters, dinners, meeting places, lanterns, etc. For organizations that are not specially related to any section of the association these arrangements are to be made through correspondence with the assistant secretary, Dr. Francis D. Murnaghan, who is to be addressed at the Washington office.

The general hotel headquarters for the meeting will be the New Willard Hotel, Pennsylvania Avenue and Fourteenth Street N. W. It is probable that some associated societies will have other hotel headquarters. A list of Washington hotels and their prices will be published later in SCIENCE and in the Preliminary Announcement of the meeting, which will be sent, as usual, to all members on or before December 1.

Reduced railway rates on the certificate plan have been granted to those attending the Washington meeting from all parts of the United States and from points in Canada, east of and including Armstrong, Fort William and Sault Ste. Marie, Ont. The certificate plan is the same as that followed for recent meetings.

It is hoped that the publicity feature of the Washington meeting will be handled even more efficiently than has been done at recent meetings of the association. The newspapers are prepared to give much space to science, and the association will do its best to furnish facilities by which representatives of the press may readily secure reliable information and may interview the men of science on their work. The subcommittee on publicity will again have the helpful cooperation of Science Service, as in recent years.

All persons who are to read papers or present addresses at the Washington meeting will aid the advance and the popularization of science very much if they will be sure to prepare *two copies* of a summary or abstract of each paper, sending one to Austin H. Clark, publicity chairman, U. S. National Museum, and the other to the editor of Science Service, Building of the National Academy of Sciences, Washington, D. C. These summaries should be sent in as early as possible. We hope for advanced summaries of all the papers given this year.

The member who made possible the thousand-dollar prize awarded at the Cincinnati meeting has very generously provided funds for a similar prize to be awarded at the fifth Washington meeting, and at the four subsequent annual meetings. The Washington prize will be awarded to the author of a noteworthy contribution to the advancement of science, presented in the programs of the association and associated organizations.

The fifth Washington meeting will be large and well attended, and plans are being made for many program features that will well represent the present status of American scientific work and scientific thought. An exhibition of new scientific apparatus, methods, books and products is being arranged. It is hoped that individuals as well as firms will exhibit. General plans for the exhibition are in charge of Dr. Chas. A. Shull, Botany Building, the University of Chicago. Prospective exhibitors are asked to correspond with him in this regard.

The opening session of the fifth Washington meeting will occur on the evening of Monday, December 29, at which Dr. Charles D. Walcott, secretary of the Smithsonian Institution, will deliver the retiring presidential address. It is hoped that the President of the United States will address the association and associated societies at the oppening session. On Tuesday evening, December 30, will occur the usual joint session of the American Association and the Society of Sigma Xi, and the session by Dr. Frederick Fuller Russell, general director of the International Health Board. On Wednesday evening, December 31, a general session will be addressed by the eminent British astronomer, Arthur Stanley Eddington, Plumian professor of astronomy in Cambridge University and director of the Cambridge Observatory. His subject will be "Relativity."

BURTON E. LIVINGSTON,
Permanent Secretary.

SCIENTIFIC EVENTS

THE PAN-PACIFIC RESEARCH INSTITUTE

THE Castle home, in Honolulu, with four acres of surrounding land, is to become the home of a Pan-Pacific scientific research institute. The property is to be used solely as a college of graduates. The assistant students will, it is expected, attend the University of Hawaii, where they will take their degrees.

The gift will be used as the nucleus of the Pan-Pacific University, for which a charter was granted some years ago. This will be a graduate university chiefly for research work. Probably a Pan-Pacific research college or institute will be granted a license by the incorporators of the Pan-Pacific University to begin work at once with a trusteeship of five scientists of Pacific races who will proceed with the organization of the research institute.

The chief work of the Pan-Pacific Research Institute will be along lines of research study of food resources of Pacific lands and of the ocean itself. It will be entirely a Pan-Pacific institute connected with no other body but cooperating with kindred bodies in all Pacific lands. It will be neither American, Ha-

waiian nor Japanese, but governed by scientists from all Pacific regions.

Conferences are being held with the heads of several delegations already there from Pacific lands, and cable invitations have been sent to others to hurry on and take part in the deliberations as to the work the institute shall undertake for the peoples of the Pacific area.

The scientists who have been for some months planning the Pan-Pacific Research Institute will make a report at the coming conference, and it is understood that the institute will begin operations at once, offering its services for the years of follow-up work needed in making the resolutions passed at the coming conference effective.

The Castle home is one of the largest in Honolulu, amply housing two score workers, with one extra outbuilding almost as large, which is excellently planned for laboratory uses. In addition there are several smaller buildings, four acres of ground, a complete set of concrete tanks and water supply sufficient for laboratory purposes. The buildings could house, beside the permanent staff, some forty visiting research scientists.

According to press dispatches, Dr. David Starr Jordan, chancellor emeritus of Stanford University, has tentatively accepted the directorship of the institute.

THE NATIONAL GEOGRAPHIC SOCIETY'S CHINA EXPEDITION

Joseph F. Rock, head of the National Geographic Society's expedition into Yunnan, southwestern Szechuan and southeastern Tibet, has just returned to this country after eighteen months in the field and reported the finding of aboriginal tribes in China practicing religious ceremonies which existed before Buddhism was introduced into either China or Tibet.

Mr. Rock found a blight-resistant chestnut tree, made observations over considerable unmapped territory, traversed a hitherto unexplored Yangtze River gorge which in places is much deeper than the Grand Canyon of the Colorado, and brought back important plant and bird collections.

The expedition's collection of herbarium specimens approximated some 60,000 sheets representing some 12,000 numbers. These plants were collected in the extreme northwest of Yunnan, Tsarong, southeastern Tibet, the independent Lama Kingdom of Mili and also in eastern Yunnan. The birds collected number about 1,600. These have been carefully skinned and prepared and labeled, and scientific data accompanies each specimen. They are from regions where few collections had previously been made. The collection contains land and water birds and in addition a few hundred mammals. The birds and mammals will be presented to the Smithsonian Institution as a gift from the National Geographic Society.

Chestnuts of apparently immune species have been presented to the Department of Agriculture, Bureau of Plant Industry. In addition a fine set of coniferous plants such as firs, spruces, hemlocks, pines and junipers were turned over to the Department of Agriculture. A large collection of seeds of rhododendrons also was forwarded to the department. Seeds of 493 kinds of rhododendron were sent to the department, by far the largest single introduction ever made into this country.

Mr. Rock's chestnuts include several species heretofore unknown to the horticultural world and perhaps even to botanical science. The chestnut introduction is of great interest to the tanning industry which has depended upon chestnut to a great extent and has recently faced the possibility of this supply being destroyed through the ravages of blight.

Mr. Rock's plant specimens were forwarded from time to time and rhododendrons also have been sent to Kew Gardens, to Edinburgh, Scotland, and to the Honorable Vicary Gibbs and A. K. Bulley, both of England, amateurs who specialize in these plants and whose collections are famous. In the United States some of them already have been planted at Golden Gate Park in San Francisco, in the Puget Sound Region and along the eastern seaboard. Further distributions are to be made in this country.

Gentians, primroses and other alpine plants, of which sets were sent by Mr. Rock, will be of great interest to gardeners in this country and in Europe. Some of these sets also have been sent to botanical gardens and plantsmen in Great Britain.

THE CENTENNIAL CELEBRATION OF THE RENSSELAER POLYTECHNIC INSTITUTE

The centennial celebration of the Rensselaer Polytechnic Institute, the oldest college of science and engineering in any English-speaking country, will take place at Troy, New York, on October 3 and 4. There will be present official delegates from educational institutions, scientific organizations and engineering societies throughout the world as well as from each alumni association and from each class since 1857. The program as thus far arranged is as follows:

October 3

Morning: Academic Procession.

Convocation. Addresses by:

Hon. Herbert Hoover, secretary of commerce of the United States.

Hon. Alfred E. Smith, governor of the State of New York.

Hon. Harry E. Clinton, mayor of Troy.

President Sir Charles Langbridge Morgan, of the Institute of Civil Engineers of Great Britain.
President Henri Abraham, of the Society of Electrical Engineers of France.
President Luigi Luiggi, of the Society of Civil Engineers of Italy.
Honorary President Roberto Gayol, of the Society of Engineers of Mexico.
President Arthur Surveyer, of the Engineering Institute of Canada.

Afternoon: Unveiling of Tablets.

1. On the site of the old main building, destroyed by fire in 1904. Address by Hon. Seymour van Santvoord, of Troy, and Mrs. James Carroll Frazer, of Washington, a lineal descendant of Stephen Van Rensselaer, founder of the institute.
2. In the Carnegie Building in memory of S. Wells Williams ('32), first professor of Chinese and oriental literature in Yale University. Address by His Excellency, Dr. S. K. Alfred Sze, Chinese Minister to the United States.

Inspection of laboratories.

Evening: Dinner in the State Armory. Addresses by:
President Livingston Farrand, of Cornell University.
Director Joseph H. Odell, of the Service Citizens of Delaware, and another distinguished speaker.
Pageant on the campus illustrating scenes in the history of science and engineering during the last hundred years.

OCTOBER 4

Morning: Convocation. Addresses by:
President Angell, of Yale University.
President Birge, of the University of Wisconsin.
President Stratton, of the Massachusetts Institute of Technology.
President Grunsky, of the American Society of Civil Engineers.
President Low, of the American Society of Mechanical Engineers.
President Kelly, of the American Institute of Mining and Metallurgical Engineers.
President Osgood, of the American Institute of Electrical Engineers.
President Michelson, of the National Academy of Sciences.

Afternoon: Reception by President Ricketts and Mrs. Ricketts.

Evening: Alumni Smoker, Pageant.

OFFICERS OF THE NATIONAL RESEARCH COUNCIL

THE list of officers of the National Research Council for the year 1924–25 is as follows:

Honorory chairman, George E. Hale, honorary director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, California.

Chairman, Gano Dunn, president of the J. G. White Engineering Corporation, 43 Exchange Place, New York City.

First vice-chairman, A. A. Michelson, president of the National Academy of Sciences; professor of physics, University of Chicago.

Second vice-chairman, Charles D. Walcott, secretary of the Smithsonian Institution.

Third vice-chairman, R. A. Millikan, director of the Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena.

Fourth vice-chairman, John C. Merriam, president of the Carnegie Institution of Washington, Washington, D. C.

Permanent secretary, Vernon Kellogg, National Research Council, Washington, D. C.

Treasurer, George K. Burgess, treasurer of the National Academy of Sciences; director of the U. S. Bureau of Standards, Washington, D. C.

Assistant secretary, Paul Brockett, assistant secretary in charge of building, National Academy of Sciences, Washington, D. C.

Assistant secretary, Albert L. Barrows, National Research Council, Washington, D. C.

Chairman, Division of Federal Relations, Charles D. Walcott, secretary of the Smithsonian Institution, Washington, D. C.

Chairman, Division of Foreign Relations, R. A. Millikan, director of the Norman Bridge Laboratory of Physics, California Institute of Technology.

Chairman, Division of States Relations, A F. Woods, president of the University of Maryland.

Chairman, Division of Educational Relations, Vernon Kellogg, National Research Council.

Chairman, Division of Engineering and Industrial Research, Frank B. Jewett, vice-president of the Western Electric Company, New York City.

Chairman, Division of Chemistry and Chemistry Technology, James F. Norris, professor of organic chemistry, Massachusetts Institute of Technology; National Research Council.

Chairman, Division of Geology and Geography, David White, senior geologist, U. S. Geological Survey.

Chairman, Division of Medical Sciences, L. Hektoen, professor of pathology, Rush Medical College; director of the John McCormick Institute for Infectious Diseases; National Research Council.

Chairman, Division of Biology and Agriculture, Maynard M. Metcalf, zoologist, Orchard Laboratory; National Research Council.

Chairman, Division of Anthropology and Psychology, R. S. Woodworth, professor of psychology, Columbia University; National Research Council.

Chairman, Division of Physical Sciences, J. S. Ames, dean of the College Faculty, professor of physics, and director of the Physical Laboratory, Johns Hopkins University; National Research Council.

SCIENTIFIC NOTES AND NEWS

THE council of the National Academy of Sciences has accepted the joint invitation of Harvard Univer-

sity and the American Academy of Arts and Sciences to hold the autumn meeting of the National Academy of Sciences in Cambridge and Boston, November 10, 11 and 12, 1924. Arrangements for this meeting will be made as usual by the local committee, the secretary of which is Dr. Edwin B. Wilson, Harvard School of Public Health.

Dr. Robert A. Millikan, recent recipient of the Nobel award in physics, has been granted the honorary degree of doctor of science by Trinity College, Dublin.

Dr. E. S. Dana, professor of mineralogy at Yale University, and Dr. Richard Zsigmondy, professor of inorganic chemistry at Göttingen, have been elected corresponding members of the Vienna Academy of Sciences.

Dr. Truman W. Brophy, of Chicago, who has gone to Luxemburg to attend a meeting of the International Society of Dentistry, of which he is president, was made an officer of the Legion of Honor by the French government on August 1.

The Moxon Medal of the Royal College of Physicians of London has been awarded to Sir Leonard Rogers, M.D., F.R.S., on the recommendation of the council.

According to the *Journal* of the American Medical Association, Senator E. Maragliano, founder of the Maragliano Institute and for nearly fifty years connected with the University of Genoa, was tendered an ovation by friends, scientific societies and state authorities on the occasion of his lecture, on June 28, when he reached the age of retirement. This last lecture was a review of what he and his school have accomplished in the nearly fifty years of his connection with the university and since he founded the Maragliano Institute. A bronze statuette medal and illuminated address were presented to him, and a banquet closed the day.

Professor H. R. Kenwood, holder of the Chadwick chair of hygiene at University College, London, will retire next December.

Under the new regulations making sixty years the age limit, Drs. Kinnosuke, Miura, W. Okada and Y. Tashiro, of the Tokyo Imperial University, have resigned their professorships.

Dr. Ray Lyman Wilbur, president of Stanford University and former president of the American Medical Association, was appointed permanent chairman of the medical council of the Veterans' Bureau, which closed its first session in Washington, D. C., on July 24.

Americans present at the twenty-first Congress of the Société des Américanistes, which opened in Sweden on August 19, included Dr. Franz Boas, of Columbia University, Dr. R. H. Lowie, of the University of California, Dr. J. W. Fewkes, chief of the Bureau of American Ethnology, and Dr. H. H. Saville, of Columbia University.

Professor A. W. Smith, head of the department of chemical engineering in the Case School of Applied Science, Cleveland, has been designated by President L. H. Baekeland to act as the representative of the American Chemical Society on the occasion of the inauguration of Robert Ernest Vinson as president of Western Reserve University and also at the dedication of the new building of the School of Medicine on October 9.

Dr. Frederick W. Zons, research chemist at the New Process Gas Mantle Co., has been appointed to head the engineering staff of the General American Radio Corporation as consulting chemical engineer.

Captain H. P. Douglas has been appointed hydrographer of the British Navy.

Announcement has been made by the United States Department of Agriculture of several new appointments to field positions in the Research Branch of the Forest Service. These are Mr. R. E. McArdle, of Norfolk, Virginia, to the new Pacific Northwest Forest Experiment Station; Mr. George B. Shivery, of Pennsylvania, to the Southern Forest Experiment Station, at New Orleans, La.; Mr. E. E. Probstfield, of Minnesota, to the Cloquet (Minn.) Forest Experiment Station, and Mr. Lester H. Reineke, of New York, at the Appalachian Forest Experiment Station, Asheville, N. C.

According to press dispatches, Captain Knud Rasmussen, the Danish explorer, has arrived at Kotzebu Sound, 150 miles north of Nome, Alaska. Captain Rasmussen left Europe in the summer of 1921 on an expedition to the Arctic regions of which the chief object was the study of the Eskimo, their customs, folk-lore, history, language and religion, and no word has been received from him for fifteen months.

Dr. Kotaro Hunda, director of the metallurgical department at the Imperial University, Tokio, will come to the United States as official representative of the Japanese government at the International Steel Exposition to be held in Boston from September 22 to 26.

Professor Goesta Forsell, Swedish authority on Roentgen-ray theraphy, has been invited to give the memorial lectures on the late Professor Eugene W. Caldwell, the American radiologist, at the Roentgen Congress in Boston, on September 3.

The Harveian Oration of the Royal College of

Physicians of London for 1925 will be given by Sir Frederick Mott.

DR. JOHN TIMOTHY GERAGHTY, associate professor of urology in the James Buchanan Brady Urological Institute at The Johns Hopkins Hospital, died on August 18 at the age of forty-eight years.

DR. ROBERT GRIER LE CONTE, the distinguished Philadelphia surgeon, died by suicide, on August 6, aged fifty-nine years.

SEYMOUR BOWER, ichthyologist and member of the United States Fish Commission, died on July 25 at the age of sixty-nine years.

DR. DAVID MACFARLAND CASTLE, of Philadelphia, physician and entomologist, died on August 6, aged eighty-one years.

FRANK A. SPRAGG, associate professor of farm crops at the Michigan Agricultural College, Mrs. Spragg, and their youngest son were killed on August 12 by a collision of their automobile with a passenger train.

SIR GEORGE BEILBY, F.R.S., distinguished British industrial chemist, died on August 1 at the age of seventy-three years.

THE Paris correspondent of the *Journal* of the American Medical Association writes that the members of the municipal council of Paris have presented to M. and Mme. Vallery-Radot, the son-in-law and daughter of Pasteur, the first copy of the memorial work published in connection with the celebration of the centenary of the great scientist. The work is from the pen of M. René Weiss, director of the cabinet of the president of the municipal council, to whom the descendants of Pasteur entrusted the valuable documents in their possession.

THE citizens of Albany, N. Y., have subscribed the funds necessary to erect a monumental statue of Professor Joseph Henry, who made the first successful experiments in long distance electrical transmission while he was a teacher in the Albany Academy from 1828 to 1831. The proposed statue will represent Henry as a young man of about thirty engaged in the demonstration of his experiments and it is intended that the figure shall surmount a pedestal bearing reliefs depicting episodes of his career in Albany, the place of his birth. The execution of the work has been entrusted to Mr. John Flanagan, the well-known sculptor of New York City, and the responsible civic body supporting the undertaking is the Albany Institute. It is understood that the money for this monument has been raised by the activities of Dr. John M. Clarke and ex-Governor Martin H. Glynn.

RUSSIAN scientists now living outside of Russia will hold a meeting in Prague, Czechoslovakia, from September 25 to October 2. There will be four sections. Professor P. B. Struve has been appointed chairman of the Section of Jurisprudence and Economy; Professor A. A. Kisewetter, chairman of the Section of Philosophy, History and Philology; Professor M. M. Novikov, chairman of the Section of Natural Sciences and Medicine, and Professor E. L. Zubashev, chairman of the Section of Pure and Applied Mathematics and Technical Sciences. A special session will be in honor of the scientific work of Professors I. P. Pavlov and N. P. Kondakov, both members of the Russian Academy of Sciences, and in commemoration of the recently deceased professors, P. I. Novgorodtzev and N. I. Androusov.

THE joint committee on definitions and standards held its twenty-sixth meeting in the Bureau of Chemistry from August 18 to 22, under the chairmanship of Dr. W. W. Skinner. Proposed standards for ice cream, meat and meat products, wheat flour, jams and jellies were discussed. The joint committee is composed of nine members, three representing the Association of Official Agricultural Chemists, three representing the Association of American Dairy, Food and Drug Officials, and three the United States Department of Agriculture. This committee recommends definitions and standards for food products for the guidance of federal and state officials in the enforcement of food laws.

THE autumn meeting of the Institute of Metals is to be held in London from September 8 to 11. On the first day the third annual autumn lecture will be delivered by W. M. Corse, of the National Research Council, on "Recent developments in non-ferrous metallurgy in the United States, with special reference to nickel and aluminium-bronze." On September 9 the general meeting will be held at the Institution of Mechanical Engineers, and a selection of papers will be presented and discussed. Following luncheon at the Connaught Room, members will visit the British Empire Exhibition. On September 10 the general meeting will be concluded, more papers will be discussed and visits will be paid to various works and to the National Physical Laboratory. On the last day there will be a river trip to Windsor and Eton.

THE sixth session of the International Commission on Illumination was held at Geneva, Switzerland, from July 22 to 25. Dr. E. P. Hyde, director of research at the Nela Park Laboratories, Cleveland, presided, and C. O. Mailloux, Clayton H. Sharp and other American delegates were in attendance. Dr. H. E. Ives, of the Western Electric Company, presented a paper on the adoption of a primary standard of light, and reports were submitted by the French and American committees. Other subjects dealt with by the commission were standards of light suitable for

photographic sensitometers and heterochromatic photometry. K. S. Gibson gave a paper on "The relative visibility function," and a resolution was passed that the commission adopt at the session being held a provisional table of values for this function. A committee was appointed to study all matters relating to colorimetry.

A chemical exposition showing chemical products of thirty different groups is to be held in Turin, Italy, during the months of September and October of this year under the auspices of several Italian chemical associations.

An international health congress will be held at Lausanne on August 4, 5 and 6, under the auspices of l'Union Internationale contre la Tuberculose.

A joint meeting of the Southern California Section of the American Chemical Society and visiting members of the American Institute of Chemical Engineers was held at the Mary Louise Café, Los Angeles, on August 1.

The twenty-eighth Congress of Alienists and Neurologists of France and French-speaking countries was held at Brussels, from August 1 to 6, under the chairmanship of Dr. Glorieux, the general inspector of psychopathic hospitals and of the colonies for the insane, in Belgium, and of Dr. Ernest de Massary, physician to the hospitals of Paris.

The American Philosophical Association has been authorized to convene the next International Congress of Philosophy in the United States during the second week of September, 1926. The place of meeting—to be more definitely announced later—will be at one of the eastern universities, not far from New York. English, French, German, Italian and Spanish will be recognized as the official languages of the Congress. Correspondence may be addressed to the corresponding secretary, Professor John J. Coss, Columbia University.

The International Conference on Health Problems in Tropical America, which was held at Kingston, Jamaica, by the United Fruit Company, was formerly opened on July 22, when the acting governor of Jamaica, Colonel Bryan, gave the address of welcome. According to the *Journal* of the American Medical Association, George E. Vincent, New York, president of the Rockefeller Foundation, and Dr. William E. Deeks, head of the medical department of the United Fruit Company, also gave addresses. The first day's program included addresses by Dr. Vincent on "International aspects of public health"; Dr. Charles Cassedy Bass, New Orleans, "The relation of the malaria carrier to malaria prevalence"; Dr. Henry Rose Carter, Washington, D. C., "The preferential and compulsory breeding places of some disease-bearing mosquitoes"; Dr. Francis Metcalf Root, "American anopheline mosquitoes and their relation to the transmission of malaria"; Dr. N. P. Macphail, Quirigua, Guatemala, "A report on the use of intramuscular injections of quinin in the treatment of malaria" and Joseph A. LePrince, Memphis, Tenn., "Can we get better anopheles and malarial control at lower cost?" Enroute to Kingston, the delegates visited the Academy of Medicine, Havana, Cuba, where Dr. Frederick G. Banting, Toronto, gave an address, after which a formal reception was held. On visiting the hospitals for lepers on July 22, the delegates were addressed by Sir Leonard Rogers, of London, on "Leprosy."

Professor K. F. Wenckebach recently summoned a conference in Vienna, at which Dr. W. B. Coffey and Dr. P. K. Brown demonstrated the technique of their operation for the relief of angina pectoris, comparing it with the operation performed by Dr. G. Hofer, of Vienna. A plan of further joint investigation was arranged and another meeting proposed for 1925.

According to the *British Medical Journal,* a meeting of subscribers to the fund which has been raised in memory of the late Dr. and Mrs. Augustus D. Waller was held at the London School of Medicine for Women, on July 17, under the chairmanship of Sir Edward Sharpley Schafer. Dr. Waller was at one time lecturer in physiology at the London School of Medicine for Women, and Mrs. Waller was first a student, then demonstrator, and later, until her death, a member of the council. It was therefore resolved that the major part of the fund should be devoted to some purpose in connection with that school. The fund collected amounts to £1,911, and it may eventually reach £2,000. It is proposed to earmark the sum of £100 as a contribution to a Waller Memorial Research Laboratory at St. Mary's Hospital, with which Dr. Waller was long connected as lecturer in physiology, if that project materializes. The remainder will be handed over to the council of the London School of Medicine for Women as a trust to be known as the Augustus and Alice Waller Memorial Research Fund. It is intended that the fund shall be used for the purchase of apparatus and materials, and for the provision of mechanical assistance and the publication of results; it is not to be regarded as in the nature of a scholarship or salary. The fund will be administered by the council of the London School of Medicine for Women, with the advice of the school committee.

Dr. W. W. Cort, who has been in China during the last year as visiting professor in parasitology at the Peking Union Medical College, will return to

Baltimore about October 1 to take up his work again in the School of Hygiene and Public Health of the Johns Hopkins University. In addition to teaching at the Peking Union Medical College, Dr. Cort, associated with Dr. J. B. Grant and Dr. N. R. Stoll, has been engaged in investigations on hookworm disease in China. Surveys and epidemiologic studies have been carried out at Chefoo, Peking, Wuchang, Soochow, Nantungchow and Canton. The headquarters of the work have been at the Soochow Hospital, Soochow, where a continuous program of experimental researches has been carried out, beginning with July, 1923. The China Hookworm Commission has worked under the auspices of the Peking Union Medical College, and has been financed by the International Health Board of the Rockefeller Foundation.

UNIVERSITY AND EDUCATIONAL NOTES

The department of medicine of the University of Virginia at Charlottesville has received the sum of $15,000 from an anonymous donor to establish scholarships in memory of Dr. Richard H. Whitehead, dean of the school from 1905–1916.

The University of Cambridge has received a bequest from the late Mrs. Constance Jenkinson for the purpose of founding a lectureship for the encouragement and advance of research in comparative and experimental embryology in the university, to be called the John Wilfred Jenkinson Memorial Lectureship, in memory of her husband, a fellow of Exeter College, who was killed in the war.

The Board of Governors of McGill University has authorized the construction of a new building for the department of electricity.

On August 1, the London School of Tropical Medicine became incorporated in the London School of Hygiene and Tropical Medicine under the directorship of Dr. Andrew Balfour. All the members of the old institution will become members of the staff of the new London School of Hygiene and Tropical Medicine.

At the meeting of the Board of Trustees of the University of Mississippi on July 29, Dr. Alfred Hume, vice-chancellor, was elected chancellor; Dr. J. O. Crider, assistant dean of the School of Medicine, was elected dean; Lloyd E. Thatcher, of the department of zoology of the University of Michigan, was elected professor of biology and embryology, and T. E. Wilson, Jr., was elected acting assistant professor of histology and physiology.

At the North Carolina State College of Agriculture and Engineering, Dr. Arthur J. Wilson, of Wabash College, and Dr. Frank E. Rice, of Cornell University, have been appointed professors in the department of chemistry.

Dr. Floyd H. Allport, formerly associate professor of psychology in the University of North Carolina, has accepted a professorship of political and social psychology in the new School of Citizenship and Public Affairs, to be opened this fall at Syracuse University.

Professor E. M. Watson has been appointed lecturer on pathologic chemistry at the Western University Faculty of Medicine, London, Ont., and consulting pathologist for Victoria Hospital.

Professor Ulrich Ebbecke, of Göttingen, has been appointed to the chair of physiology at Bonn, vacated by Professor Hofman.

DISCUSSION AND CORRESPONDENCE

NEW CASTS OF THE PITHECANTHROPUS REMAINS

In the beginning of July, 1923, during the writer's visit to Professor Eugene Dubois, to examine, at the latter's invitation and after their long seclusion, the highly important originals of the *Pithecanthropus*, the need of new and reliable casts of all the remains was urged upon Professor Dubois, who promised to comply as soon as circumstances permitted. On July 10, this year, the following gratifying and self-explanatory letter was received:

"Dear Dr. H.

To-day I have forwarded to the Koninklyke Akademie von Wetenschappen, Amsterdam, casts of all the fossil remains of *Pithecanthropus erectus:* the calvarium, the endocranial cavity, the femur, the three teeth and the mandibular fragment, for the U. S. National Museum, Smithsonian Institution, Washington, D. C.

I beg to excuse the late date of this, a year ago promised sending, by my having been seriously indisposed during a long time and the circumstances that we have no specialist in this country to make casts of this kind, so that the work had to be done for the greatest part by my own hands.

Believe me sincerely yours,

(Sgd.) Eug. Dubois."

It is understood that two other sets of these casts have been made, one of which is destined for the American Museum of Natural History.

Aleš Hrdlička

U. S. National Museum

AS STUDENTS UNDERSTAND IT

I think it was President Eliot who used the expression, "The incredible incapacity of the average student to receive instruction."

During 36 years, 34 of which have been continuous at one institution, of active work in teaching—per-

haps, from what follows, I should say, in trying to teach the biological sciences, one is apt to have had experience with various types of student mentality and to have learned something of the intricate cerebrations of student aspirants to wisdom.

One can expect a certain amount of misspelling of scientific terms, such as "Senterpede; Bile Ducks; Liver fruit (flukes)," and so forth. These will always occur under the present system of teaching spelling in the lower schools.

Looking over a list of choice and rare gems of student misinformation evidenced in written answers, which has been gleaned from actual test papers during a long period, the following actual answers would seem to have been faked, or to be the lucubrations of a disordered imagination.

The following are among the more amazing:

Enzymes are plants having hairs that are inactive; such as cactus and onion.

Root-tubercle bacteria attack the roots, causing them to die, and it is due to the decay of layer or top of layer of plants and vegetable matter that causes the production of fuel.

By metamorphosis is meant the change in form which takes place in animals in whose life history metamorphosis takes place.

Pollination is a process by which the ovary of the stamen is fertilized by the pollen which comes from the *antlers*.

Malaria is caused by a certain kind of mosquito, and in a little while he has yellow fever. Of course every kind of louse does not carry yellow fever.

Sporozoa is a disease caused by certain forms of bacteria.

Birds have one antiseptic kondyle (Occipital condyle).

An antiseptic is something that prevents or stamps out fumigation.

Bacteria are used when vaccinating a person for disease; again they are used in spraying plants.

Vertebrates are mammals or man, such as birds, lizards, reptiles, snakes, fish, whales.

A notochord is an animal that has not a backbone.

Arthropods have the nerve system on the Bellephloem (Belly floor?).

A metamorphosis is a sucking insect and is very injurious to trees.

Placenta is center of some animal element which is surrounded by some more of animal substance not as vital as it.

An insect is a vertebrate and invertebrate animal, having no true back bone.

Liver-flukes attack the tail of the animal, which excited, moves its tail; this is kept up until finally the tail falls off.

Chinch-bugs may be controlled by use of carbon bisulphide gas on the outer rows of a corn field.

Reptiles have two or more pairs of limbs, such as the locust and others.

O Tempora, O Mores!

Ellison A. Smyth, Jr.

THE SCIENTIST AND AN INTERNATIONAL LANGUAGE

In the current (June 20) issue of Science I have noted the communication of Dr. Roland G. Kent on "The scientist and an international language." The need for an international language is great both in science and in other fields. It is perhaps possible to conceive that the translation of articles upon scientific subjects into Latin would be relatively easy for a very few men, but for most of us such a thing would constitute a *tour de force,* in fact a practical impossibility, even assuming that we had at hand an adequate "unabridged" English-Latin dictionary of modern scientific and technical expressions.

To express modern ideas in Latin requires exceedingly ingenious, not to say clumsy, circumlocutions. The technical dictionaries in the vernacular are always far behind the daily and common use of technical and scientific expressions and the best dictionaries contain but a portion of the technical terms. As an example I might cite the fact that nearly half of the 1,200 milling and baking terms which I have compiled are not found in "Webster" or the "Standard."

A Latin glossary is perhaps possible for sciences like botany, and without doubt a commission could translate or transliterate most of our modern chemical terms, but it would not be quite so feasible in the social sciences and would certainly be difficult in the mechanical arts. In high school and university I devoted five years to Latin, one year to Greek and four years to German, also taking a little French and Spanish, yet I should certainly hopelessly fall down if the task were given me to describe in Latin a walk around Lake Calhoun, let alone writing an article on measurement of viscosity or talking to a foreign chemist regarding the specific rotatory power of a soluble carbohydrate.

In scientific work we could not get along without modern scientific equipment such as pyrex and silica glass, dictaphones and audion valves, and it is certainly not in line with progress or convenience to think of going back to antiquated modes of expression even though that could be accomplished. We have gone beyond the Roman notation and adopted the very simple and easier Arabic notation. We have adopted universal musical notation and have nearly come to full use of the metric system. Why should we hesitate to adopt Esperanto, which nearly if not completely possesses every desired quality which an international language should possess?

Dr. Kent asserts that any artificial language can not convey the thought with objective certainty, but that Latin is unsurpassed in this respect. I have for many years made the most practical use of Esperanto in gathering scientific information from non-scien-

tific and scientific men in all quarters of the globe and wish to say that I have found it capable of expressing with exactness shades of meaning which one finds difficult to express in English. The ability of the Greek in this particular is only surpassed by Esperanto with its highly ingenious prefix and suffix system in forming readily understood yet exactly defined expressions.

It was not necessary for me when first I happened on the word "disaudigi" to understand that it meant "to broadcast": *dis*—in different directions, *aud*—hear, *igi*—to cause to. Esperanto has been termed modernized and simplified Latin and "the least common multiple of the European languages." It is not in the true sense an artificial language. Probably 75 per cent. of the roots are of Latin origin, and the very simplicity of the grammar constitutes the best argument for its use as a scientific tool. It is not the words and names that make a language difficult but the grammatical gender, the idiomatic expressions, the similarity of case and verb endings, etc. The grammatical construction of Esperanto is easily mastered by any intelligent person in an hour's study.

Consider for a moment the complications of Latin inflections, for instance, the ending *is* in nouns and adjectives in the dative and ablative plural of the first and second declensions, the genitive singular and many nominative and vocative singulars and accusative plurals of the third declension, occasional genitives in the fourth declension; in verbs many second person singulars and most second person plurals; also a number of adverbs.

The Committee Appointed to Inquire into the Practicability of an International Auxiliary Language of the British Association for the Advancement of Science favored Esperanto and named the disadvantages of Latin. The American Association would do well in its efforts for the advancement of science to follow the lead of the British, French and Italian Associations, the first Pan-American Scientific Congress in 1909, the World Union of International Associations, and numerous other commercial and international organizations and the Central Office of the League of Nations, by endorsing and making use of Esperanto for the purposes for which Dr. Kent proposes Latin.

If difficulties exist they are certainly minor ones which can be overcome, and the point must not be lost sight of that the purpose of an international language is to gain quickly and exactly the information presented by a writer. This will be the more easily possible if the writer expresses his thoughts clearly and simply, and it is a pleasure to assure those who have not used Esperanto that it is an easily used tool of exceeding sharpness and accuracy to which one quickly becomes accustomed. Those who have attended international congresses where Esperanto has been used have always commented on the fluent speech and the obvious understanding which existed, and the smoothness of the transactions in contrast with the tedious proceedings and interruptions for translation at congresses using several national languages.

We might perhaps compare the use of Latin, German and Esperanto in the translation of an article to the comparative pleasure that would be experienced in attempting to drive a wind-broken nag, a 1907 model auto and a 1924 six or eight cylinder coupé on a twenty-five mile trip.

Charles H. Briggs

Minneapolis, Minnesota

I have seen the letter of Mr. Charles H. Briggs, of Minneapolis, regarding my recent communication on "The scientist and an international language," and desire to make a brief reply.

The difficulty with the use of Latin as the international language for the scientist is not that which is mentioned by Mr. Briggs, but the fact that the budding scientists have not been brought to the study of Latin with the idea that it will in the future be their medium of international communication. If such an attitude had been inculcated, we should see to-day very different results from the study of Latin and should find many more scientists glad to accept the services of the Latin language.

Mr. Briggs's own statement that "probably 75 per cent. of the roots (of Esperanto) are of Latin origin" virtually concedes the case in favor of Latin, in the matter of vocabulary. As for ease of word formation, nearly all the suffixes of Esperanto which form nouns and adjectives, and most of the other formative elements, are taken direct from Latin or from Greek, and are as easily usable in Latin as in Esperanto. It is clear to any one familiar with etymologies that virtually all technical vocabularies in English are of almost exclusively Latin and Greek origin. Probably all of them are, without exception, but from scholarly caution I insert the *virtually*. It happens that I do not know the terminology of milling and baking, but I should be very glad to make an etymological analysis of it, if it should be submitted to me. And while I admit that I could not write in Latin a technical treatise on milling and baking, nor on most other natural scientific subjects, I could not do it in English either. Yet I can see what the Latin would be for the "specific rotatory power of a soluble carbohydrate," since every word is already Latin except the *hydr*, which is Greek and can be used freely in Latin; and as for a walk around Lake Calhoun, I shall be pleased at any time to demonstrate the ease with which it can be described in Latin, if Mr. Briggs will furnish me with the English text: the lake is unknown to me personally.

The other differences between Mr. Briggs and myself are matters of opinion. But in considering them, one must not forget that the Esperantist has almost always approached the study of Esperanto with a considerable previous study of other languages, sufficient to render language study easy to him, and with an enthusiasm raised to a high pitch by repeated assurances that Esperanto is extremely easy. Professor R. A. Muttkowski develops this theme very effectively in *America* for December 30, 1922. But of these two factors, the former is not intrinsic in Esperanto, and the second is extraneously stimulated. Grant the same mental attitude toward Latin or toward any other language as that which has been developed toward Esperanto by its advocates, and the rate of progress would be enormously accelerated. But this is not normal. One may note that Professor Leskien, the great linguist and philologist of Leipzig, found it very difficult to gain a mastery of Esperanto, though he devoted several hours a day to it for three months, and he was a man who spoke a number of modern languages, including several Slavonic languages, which are reputed to be very hard to learn.

Roland G. Kent
University of Pennsylvania

SCIENTIFIC APPARATUS AND METHODS

ARTIFICIAL CULTIVATION OF FREE-LIVING NEMATODES

The artificial propagation in pure culture of microscopic organisms, wherever it has been successfully applied, has opened the road to discoveries of the most important and most diversified kinds. The development of cultural methods for the study of bacteria by Pasteur will always stand as one of the important milestones in the progress of bacteriological science. Since Pasteur's time numerous refinements have been made in cultural methods, particularly the introduction of solid media by Koch, and great extensions have been made in the application of this method of study to organisms other than bacteria and fungi. Spirochetes, free-living protozoa, trypanosomes, Leishmaniae, intestinal flagellates and even malarial parasites have been successfully grown in culture, either pure or in conjunction with organisms on which they feed.

So far as I am aware the propagation in pure culture (pure as far as metazoan species are concerned) on artificial media of free-living nematodes has not previously been recorded. I recently made the discovery that certain species of free-living nematodes would thrive and multiply at an astounding rate on ordinary nutrient agar plates. A single isolated adult female of Rhabditis sp., placed on an agar plate with a drop or two of dirty water to supply a bacterial growth, in a period of five days produced hundreds of offspring which swarmed all over the plate. In ten days the offspring numbered many thousands—males, females, eggs and young in all stages of development. The majority of the individuals are found moving about on the surface of the agar, but some burrow into it also. The movements on the agar are sufficiently impeded so that they can be watched after the fashion of a slow-moving picture. The swallowing of bacteria and fungus spores, the excretion of waste matter from the anus, and every detail of locomotion can be observed under ideal conditions. I have succeeded in culturing at least two different species of Rhabditis, a Cephalobus and others which are not positively identified. A pure culture, *i.e.*, a culture containing only one nematode species, seems to develop more rapidly than a mixed culture.

Cultivation of free-living nematodes in this manner suggests a great range of possibilities in the way of study and experimentation, *e.g.*, on foods, effects of hydrogen ion concentrations and of chemical substances, resistance to desiccation, tropisms, effect of various modifications in environment on rate of reproduction and development, etc. In the case of beneficial or injurious species, it might lead to the discovery of methods for controlling or encouraging them. The extremely rapid rate of reproduction and ready inbreeding suggests great possibilities in the way of genetic experiments.

Cultivation on agar plates also furnishes a convenient method of obtaining large quantities of material for taxonomic study, in all stages of development. A drop or two of water washed over the surface of the plate and then placed on a slide with a little ether gives a large number of perfectly clean nematodes for microscopic examination.

For class demonstration the cultivation of the soil nematodes on agar plates is ideal. If a student places a small quantity of soil, especially manured soil, in a piece of gauze or in a fine sieve, and washes it in a beaker of water of about 100° F., for a few minutes, the majority of the nematodes present will fall to the bottom of the beaker. A drop or two of water from the bottom of the beaker is placed on the surface of the agar, the plate is covered and left at room temperature for a week or two and then examined under a microscope. I can guarantee from personal experience that the result will be startling.

Further investigation on the cultivation of these nematodes, especially its application to a larger number of species, had been planned before publishing the work, but an unexpected change in my plans makes it improbable that it can be continued for some

time to come. In order, therefore, that others who are interested in the study of free-living nematodes may pursue the matter further, this preliminary note is published in its present incomplete state.

ASA C. CHANDLER
BIOLOGICAL LABORATORY,
RICE INSTITUTE

SPECIAL ARTICLES

ELECTRIC CONDUCTIVITY OF RED BLOOD CORPUSCLES USING HIGH FREQUENCY ALTERNATING CURRENTS[1]

RUDOLPH HOEBER determined the electric conductivity of suspensions of erythrocytes in isotonic sugar solutions by various substitution methods. He used damped alternating currents of radio frequency for the high frequency currents. Owing to the fact that high frequency apparatus has been very much improved, and it is now possible to obtain undamped alternating currents of any desired frequency, it seemed desirable to make some new determinations. During the past nine months I have spent much time in the attempt to observe a difference, if any exists, between the conductivity of erythrocytes as measured by continuous currents in contrast to that measured at about one thousand cycles per second. It was found that calomel electrodes of large size showed so little polarization during the passage of a small current for fifteen seconds that these could be used for running the current into and out of the erythrocytes. Apparatus was made which reversed the current every fifteen seconds and the final reading was verified during one fifteenth-second interval. The electrode vessels were separated from the erythrocytes by means of agar gel made up with saturated potassium chloride solution. After many methods were tried, a Wheatstone bridge method was finally used. No difference in conductivity with direct current and with a thousand cycles could be established with certainty. Attempts were next made to detect a difference between the conductivity at one thousand and one million cycles. The current of a thousand cycles was generated by a Vreeland oscillator and gave a pure sign wave as shown by the oscillogram. A million cycle current was produced by an electron tube oscillator. This frequency is too great to be studied by the oscillogram, but it is a general opinion of radio engineers that such currents show harmonics. No better source of current, however, was known at this frequency. Measurements made with a bridge whose known resistances were wound according to the Ayrton-Perry winding were very unsatisfactory at a million cycles, although this bridge gave very good results at fifty thousand cycles. Therefore, a very simple and symmetrical bridge was constructed in which the metallic resistances were straight wires and the detector was a crystal detector and sensitive galvanometer. No theoretical defect in this bridge was known, and since no more suitable arrangement has yet been used, the results are taken to be provisionally correct. It was found that the specific conductivity of a sediment of ox-erythrocytes containing a small percentage of serum was 0.001 reciprocal ohms at one thousand cycles per second, and was 0.0014 reciprocal ohms at a million cycles per second.

Hugo Fricke has made some measurements of the capacity reactance of living cells. In order to interpret his data as capacity reactance, certain assumptions had to be made. If it is really true that the conductivity is greater at high frequency and that the cells show capacity reactance, a simple and time-honored picture of a cell which would show these phenomena is one in which the cell interior is a moderately good conductor of electricity but the cell surface acts as a dielectric and insulator. When a direct (continuous) current is passed through a sediment of the cells, the current passes through the film of medium separating the cells and does not pass through the cells themselves to any large extent but when a high frequency alternating current is passed, it passes through the medium as well as before and in addition to that it passes directly through the cells, the insulating surface of each cell acting as the dielectric of a condenser.

These preliminary measurements are published owing to the fact that the work will have to be interrupted during the summer.

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[1] Aided by a grant from the American Medical Association.

STINGING CRYSTALS IN PLANTS

STINGING crystals are widely distributed throughout the vegetable kingdom. They are in the form of raphides, composed of calcium oxalate, and their action is generally regarded as mechanical. As a matter of fact, however, the mechanical effect of such crystals is not the sole cause of the irritation, though this is a contributing factor. Calcium oxalate in the form of raphides is common particularly in the Monocotyledons, but by no means always do they have stinging properties. Some other factor must be looked for. For the purpose of this investigation the Cabo Negro palm (*Arenga pinnata* Merr.), the dumayaka (*Arenga tremula* Becc.) and the pungapung (*Amorphophallus campanulatus* Blume) were used. In the first two the crystals occur in the fruit in a layer of cells on the inner side of the endocarp;

in the pungapung the crystals occur in the stems and leaves.

Application of the crystals to the skin produces a violent irritation which continues for a considerable period of time. This property is made use of in the Philippines for the protection of fish ponds against robbers. The crushed fruits of Cabo negro are scattered along the edges of the ponds, and make a very effective barrier against bare-footed intruders.

Many of these plants containing stinging crystals are used for food purposes. Prolonged boiling renders them harmless, and microscopic examination shows that the crystals have been destroyed. The irritation produced by the fresh material is very similar to that produced by the latex of the unripe papaya (*Carica papaya* L.), in which the active agent is the proteolytic enzyme papain. This affords a hint as to the reasons why irritation is produced by some plants with raphides, and not with others.

Four possibilities may be taken into account: (1) Irritation may be due to the mechanical action of the crystals; (2) It may be due to organic acids; (3) It may be due to an enzyme; or (4) It may be due to a combination of (1) and (2) or (1) and (3) or a combination of all three.

A strong infusion of the crushed tissue was filtered over a suction pump. The filtrate, though devoid of crystals, was found to produce irritation when left in contact with the skin, but its action was not nearly as violent as when the crystals were present. Scratching of the skin followed by application of the filtrate produced much more comparable results. The conclusion, therefore, is that the crystals are essential to the production of the full amount of irritation, but that the active agent which produces the effect after the first mechanical action of the raphides (which may be reproduced experimentally by pin pricking) is some substance associated with them. This is not an acid, as the liquid is slightly alkaline in the case of the palms and neutral in *Amorphophallus*. In *Laportea* and *Urtica* (*Urticaceae*) it has been shown that the irritation is due to formic acid, injected after the skin has been pierced by the siliceous trichomes. The mechanism in the cases of stinging hairs may, therefore, be compared to that of stinging crystals. Mechanical piercing is followed by the further action of an irritant. Bearing in mind the similarity in sensation produced by these crystals with that produced by the latex of the papaya, some confirmatory experiments were carried out with the result that conclusive proof was produced that the irritant was a proteolytic enzyme. Within little more than an hour cubes of hard-boiled white of egg were appreciably corroded when immersed in the juice. Ammonia and metallic salts (such as mercuric chloride) acting as enzyme inhibitors when added to the juice destroyed its irritating properties for the most part, though the annoying prickling of the raphides could still be felt.

The custom of boiling the tissues of plants containing stinging crystals before using them for food has two objects. First, heating with water dissolves the crystals, and second, the heat destroys the enzyme.

SUMMARY

The results go to show that in the case of plants with stinging crystals, the action consists of two distinct stages: (1) The mechanical action of the raphides in piercing the skin; (2) The entrance through the minute wounds of a proteolytic enzyme which is the cause of the greater part of the effect.

The removal of the crystals by filtration or the destruction of the enzyme will not eliminate all the irritating properties, but the two actions together are sufficient, and so the action must be regarded as being produced by combination of the two factors.

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THE WESTERN SOCIETY OF SOIL MANAGEMENT AND PLANT NUTRITION

THE Western Society of Soil Management and Plant Nutrition held its third annual meeting on June 24 and 25, commencing one day in advance of the regular session of the Pacific Division of the A. A. A. S. Twenty-five members attended and participated freely in the discussion of the papers.

Four half-day sessions and a business meeting were held and the following program was presented:

SOIL ALKALI AND SOIL ACIDITY

Replaceable bases in relation to soil acidity and the theory of replaceable bases: W. P. KELLEY.

The relation of certain alkali salts to the growth of plants: A. R. DAVIS and D. R. HOAGLAND.

Tolerance studies for alkali soils in Idaho: R. E. NEIDIG and H. P. MAGNUSON.

The injurious after-effects of sorghum: J. F. BREAZEALE.

THE SOIL SOLUTION

Nature and promise of the soil solution: J. S. BURD.

Secular and seasonal changes in the soil solution: J. S. BURD and J. C. MARTIN.

Some physiological aspects of soil solution investigations: D. R. HOAGLAND.

Soil structure and the soil solution: M. D. THOMAS.

Replaceable bases in relation to the soil solution: W. P. KELLEY.

PLANT NUTRITION

The stimulation effect of NaCl upon respiration and growth of wheat: A. R. DAVIS and L. J. TEAKLE.

The relation of potassium to the formation of diastase in wheat seedlings: A. R. Davis and J. L. Doughty.

The growth of plants under controlled environments. I—Electric light as a source of illumination: A. R. Davis.

The significance of the temporary depletion of certain essential mineral constituents in the soil on plant growth: W. F. Gericke.

Fertility experiments in Oregon: W. L. Powers.

The moisture equivalent as influenced by the amount of soil in this determination: F. J. Veihmeyer, O. W. Israelsen and J. P. Conrad.

Capillary potential measurements for the Greenville soil: Chester A. Chambers and Willard Gardner.

Routine testing of alkali soils in the laboratory (demonstration): P. L. Hibbard.

The soil profile as a basis for soil classification: C. F. Shaw.

Some chemical effects of sulphuric acid on alkali soils: C. D. Samuels.

The officers for the ensuing year are: D. R. Hoagland, University of California, Berkeley, *president;* H. P. Magnuson, University of Idaho, Moscow, *vice-president;* M. D. Thomas, Utah Experiment Station, Logan, *secretary-treasurer.*

THE WESTERN BRANCH OF THE AMERICAN SOCIETY OF AGRONOMY

The Western Branch of the American Society of Agronomy held its eighth annual meeting at the University of Wyoming at Laramie, Wyoming, on July 21, 22 and 23. About fifty agronomists were present, coming from twelve states and the U. S. Department of Agriculture.

The program was as follows:

"Address of Welcome." A. G. Crane, president of the University of Wyoming.

"Response." F. J. Sievers, president of the Western Branch of the Washington Experiment Station.

"Roll-call." Each man gave his name, position and a brief statement of his work.

Crop standardization and registration of seeds: A. G. Ogaard, extension agronomist, Montana State College.

Ladino clover seed production and its value as a pasture crop: R. L. Spangler, assistant agronomist, University of Idaho.

Some extension methods of field crops work: Waldo Kidder, extension agronomist, Colorado Agricultural College.

Investigation of livestock losses on sweet clover pasture: Clyde McKee, agronomist, Montana State College.

Problems in agronomy as they are related to the production of range and dairy livestock: O. S. Fisher, extension agronomist, U. S. Department of Agriculture.

The plan for the development of a regional program of extension work in farm crops: E. Merritt, field agent, Extension Service, U. S. Department of Agriculture.

A comparative study of hardiness of wheats: John H. Martin, agronomist, Western Wheat Investigations, U. S. Department of Agriculture.

Drill calibration and its relation to stand and yield of small grain: H. W. Hulbert, agronomist, University of Idaho.

Critical periods for irrigation of wheats: D. W. Robertson, assistant agronomist, Colorado Agricultural College.

The prevention of insect attack on stored grain by carbonate dust: W. W. Mackie, assistant agronomist, University of California.

Predicting wheat yields: O. R. Mathews, assistant in dry land agriculture, U. S. Department of Agriculture, Newell, South Dakota.

Natural crossing of oats: F. A. Coffman, agronomist, Cereal Investigations, U. S. Department of Agriculture.

Relation of temperature and rainfall to date and rate of seeding: A. F. Swanson, Hayes Experiment Station, Kansas.

Improving the quality of American-grown durum wheats: J. A. Clark, agronomist, Western Wheat Investigation, U. S. Department of Agriculture.

The nitrogen problem from the Kansas point of view: P. L. Gainey, soil bacteriologist, Kansas State Agricultural College.

The soil nitrate problem in Colorado: Alvin Kezer, agronomist, Colorado Agricultural College.

The deleterious effect of sorghum in the soil on succeeding crops: R. S. Hawkins, agronomist, University of Arizona.

The tillering of grain as related to the yield and rainfall: Ralph W. Smith, assistant agronomist, Dickinson Substation, North Dakota.

Range losses on poisonous plants and their control: O. A. Beath, chemist, University of Wyoming.

Outstanding weaknesses in agronomic investigational work: F. J. Sievers, agronomist, Washington State College.

At the business meeting Wednesday morning it was decided to hold the next meeting at Fort Collins, Colorado, either just before or just after the meeting of the Western Branch of the American Association for the Advancement of Science, at Boulder. Clyde McKee, of Montana, was elected president for the ensuing year and D. W. Pittman, of Utah, secretary, Alvin Kezer, of Colorado, being automatically the other member of the executive committee.

There was an inspection of the Wyoming State Experiment Station farm and its work on July 22, and on Wednesday afternoon the visitors were taken in cars on a trip to the Medicine Bow Mountains, after which a trout supper was enjoyed at Centennial. After the supper, remarks were made by Dr. H. L. Westover, Professor F. J. Sievers and President A. G. Crane.

SCIENCE

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THE RESEARCH SPIRIT IN MODERN LIFE[1]

For four years, living in this delightful community, under the guardianship of this great institution, participating in its benefits, drawing from its rich sources of supply, both material and intellectual, you young men and women have been through a process of development that marks a most important stage in your life career. But to-day we may not look only upon the memories of the past four years, but with januform vision look forward as well and realize that we are at the commencement of a long period of life, for the most part, alas, unprotected by the motherly arms of the university and the cooperative efforts of class, fraternity and sorority mates.

It is indeed the unusual undergraduate who senses the true privilege that he is enjoying by life in this community. The money he contributes is but a small fraction of the cost entailed in providing the educational facilities here to be found. Everywhere about this campus there are evidences of the munificence of the state, the town and those who have passed on and who in grateful memory of what they have received here have attempted in manifold ways to repay their debt.

Laboratories, libraries and indeed fraternity and sorority houses are all evidences of the appreciation of those who have stood exactly as we are standing on this eventful day, many years ago. For four years this campus has seen you all, going hither and thither, each occupied with his or her problem, but each necessarily, perhaps subconsciously, mindful of the community's welfare. While everywhere one finds that freedom of action and freedom of speech have been encouraged, nevertheless no man can assert his rights if those rights are not sane and unobjectionable to the majority of his classmates, for with freedom of speech comes responsibility and weighing of words. So college life has taught us that each, personally, must have the welfare of others at heart.

The underlying spirit which has so coordinated the entire community life and has made for betterment of the moral and physical and intellectual body has been that of trying, experimenting, proving, developing, for progress even in the smallest degree can only be made or attained by experiment, although with a community as large and with the wide diversity of interests as is here found, obviously much of its life rules and principles must have been preformulated.

[1] Commencement address given at the University of Maine on June 9.

Nevertheless a moment's reflection will show that this university is by no means the same university that it was four years ago, when you entered it. Even in this brief span of time there have been most profound changes. I am not speaking solely of the material but chiefly of the intellectual, the habit of thought and the line of reasoning, all of which are produced by an unceasing development of the spirit of unfolding, searching for the new, proving, testing. This spirit we may properly call the spirit of research. The common use of the word "research" which is so often, in my judgment, erroneously confined to the research and study for material development fails to express the broader and cultural significance of the word.

Individual effort, though the basis of all research, must be directed not to selfish but to communal welfare. Prehistoric man could advance but little as a single member of society; he could alone make but feeble headway against the vicissitudes of life, but the clan and the patriarch, with his family gathered about him, moved and worked all in the interests of the group. The needs of early man were few, and it was only slowly (perhaps in time reckoned in thousands if not in tens of thousands of years) that the simplest commodities became available to him. Thus fire, that greatest agency for the development of mankind, came into the hands of primitive man very late and probably as a result of accident. No other single agency made possible such fundamental alterations in primitive man's whole method of living. His first knowledge of it was undoubtedly the aftermath of the thunderbolts, and lightning flashes, with devastating forest fires, which filled him with great terror. Far from being inclined to duplicate these frightful events, he would seek to avoid contact in any way with such an agent, and it is rather difficult to imagine that the cave-dweller realized the development of heat by friction, the sparking of flint and ignition therefrom, or the concentration of the sun's rays by means of a spherical mass of crystal or of ice, so in all probability this great asset came to man as a result of accident.

Controlled fire with its incalculable advantages is probably the best example of man receiving into his hands by accident mastery of one of the greatest forces of nature, and yet we may possibly be doing injustice to some mute, inglorious Franklin, who by some subtle spark of genius and thought may have planned simple tests or efforts to secure this commodity. One could almost wish that one could be assured that such were the case, for it is a fact, at the present date, that additions to our knowledge, proving of material value to the world, are rarely the result of accident but are usually the end-result of a long, painstaking series of carefully developed plans and concentrated efforts upon a pre-conceived and hoped-for end. Undoubtedly when one considers the innumerable inventions of the present day, *some* were the result of accidental findings, but few, if any, great discoveries are based upon accident, for a great invention is one that involves utilization, classification and interrelation of one or more great basic principles upon which all our material progress is founded.

It is this method of attack that is exemplified in its highest form in research. With each new development there accumulates with almost geometric ratio a widening of activity, control of forces, utilization of powers formerly undreamed of. Without doubt our cave man immediately applied his control of fire to the preparation of foods, thus resulting in altering his diet. It made possible his excursions into colder climates and it gave him an agent in combatting the maraudings of wild animals and, indeed, at times his fellowmen.

So with each research problem successfully completed at the present day our field of endeavor immediately widens. Franklin's daring in drawing electricity from the clouds with his kite but a little over a century ago has broadened now into such a diversity of uses of electricity that the mind staggers with its efforts even to classify them. And yet all this has happened within, relatively speaking, a few hundred years. It has been recently asserted that in all probability man in essentially an unaltered physical form will be upon this planet for not far from four or five million years. During this time there is no reason to suppose that there should be a cessation or retardation of progress, so that in a way we are simply at the threshold of human development, and while we find ourselves surrounded by all sorts of comforts and luxuries undreamed of, yet, as surely as we are here to-day, in 200 years we will be considered almost as a primitive people.

The side wheel steamer of 60 years ago is fast disappearing. Who cares or, indeed, *dares* to ride the high wheel bicycle, and Fifth Avenue is without its splendid horse-drawn equipages that dazzled the beholder by their luxury and elegance hardly 20 years ago. These are the effects. The cause is the development of research in transportation agencies, giving us the propeller, the modern bicycle and the automobile. These are all the result of *design* and not accident.

On one of those white marble buildings comprising that magnificent group of research centers at the Harvard Medical School there is a tablet showing that this particular building was the gift of Mrs. Arabella D. Huntington in memory of her husband, Collis P. Huntington, the great railway magnate. Former President Charles W. Eliot, with his inimitable style, wrote for this tablet a few words which

embody so perfectly the spirit of research that they should be on the wall of every educational institution. The inscription reads: "Life is short and the art long, the occasion instant, experiment perilous, decision difficult." In no other way could one in so few words express the entire spirit of research, for this is really an epitome of the research spirit with the dominant note *design* and not accident. Let us read again this tablet. "Life is short." In the progress of science nothing could be shorter than life. When our paleontologists are discussing prehistoric man in the terms of tens of thousands of years and when our prophets are implying that we have still some millions of years to live, each of those organisms known as man has but a brief, transitory sojourn on this earth. What a depth of meaning there is in the expression "The art is long." What is more enduring than the art? And by the art one does not mean simply the esthetic expression of man's sublimest thoughts in the form of prose or painting or chiselled stone or monumental pile, but all that man can by skill, thought and plan contribute to civilization.

Again we read, "The occasion instant, experiment perilous." In these advancements which must inevitably continue with man's prolonged existence there are periodic instants where the occasion for observation, for test or proving may exist for but a very short time. To distinguish between the essential and the non-essential is one of the most difficult features in developing observational powers. The danger of not making the critical experiment at the proper time is indeed perilous, perilous to progress. The perilous nature of experiment rarely involves danger to the life of the individual making it, and yet history affords instances of such occurrences.

But when we think of the heroic tests of Major Walter Reed and his associates, when by submitting to the poisonous, death-dealing sting of that pestilential yellow fever carrier, the mosquito, they sacrificed their bodies on the altar of science, one can truly say that experiment is perilous.

The entire path of the research worker is strewn with difficulties, but, after all, the most difficult things are the best things, the things most appreciated, the accomplishment of which is accompanied by the greatest gratification. Difficulties begin immediately with the assessment of the values of earlier work, as to what is to be saved, what is to have bearing upon the new problem, and what is to be rejected. The experimental conditions, with their technicalities and niceties of adjustment, present further difficulties. The discrimination of the essential from the non-essential in observation next presents difficulties, and above everything else there is the greatest difficulty in interpreting results of experimentation, so that the words "decision difficult" are continually before the research worker.

True research must take into consideration past experience, a careful survey of what has gone before, with a particular view as to the correct path to follow, and *then* the attack upon the problem under investigation. Accident has little, if any, place in a research program. Yet at times there are of course fortuitous discoveries of wonderful importance. The great transcontinental railroads in cutting through a mountain are bent upon securing the most direct route of transportation, but do not the marvellous fossil remains accidentally uncovered in connection with their excavations unfold innumerable pages of past history? On the contrary, Benjamin Franklin's drawing electricity from the air during a thunderstorm with his kite and key was by no means an accident. Here we might well repeat Dr. Eliot's words, "The occasion instant, experiment perilous."

To what extent research enters into modern life can best be seen when one realizes that all our largest industrial organizations have definite sections devoting a large part of the time of a considerable number of workers to research, mainly, it is true, on problems of specific economic interest for the corporation. While of course many processes are retained as "trade secrets," a very large amount of the work is published and thus made available for all mankind. So important an influence upon the success of the corporate existences are these research divisions that a definite budget is assigned to them, and in making up the cost of *your* electric light bill or *your* telephone bill unquestionably a certain fraction is definitely assigned for further research. The reason that our telephone instruments are so superior, that our photographic films are of such a high quality, that our X-ray tubes are capable of such marvelous penetration, is due to the fact that the Eastman Kodak Company, the General Electric Company, the Westinghouse and the Western Electric Companies recognize research as an integral part of their system. The remarkable group of men that the General Electric Company has devoting their entire time to research need only be listed to show the importance of this phase, for where will you find such men as Elihu Thomson, W. R. Whitney, Coolidge, Langmuir, and, I am happy to add, a distinguished graduate of this university, Dr. E. R. Berry. What the physician owes to Coolidge for his work on the X-ray tube can not be adequately expressed Professor Thomson's and Dr. Berry's work upon fused quartz has hardly been opened. The possibilities of applying quartz to medical and optical purposes lie far beyond the original intent of the General Electric Company to secure a better insulator for high tension currents—of itself an achievement of no small distinction.

The telephone and telegraph companies would be tremendously handicapped without men like General J. J. Carty and Professor M. Pupin. The experience of many of these men reads like a novel. Those of you who have read Professor Pupin's marvelous autobiography "From Immigrant to Inventor" can trace out there the development of one of the foremost men of research in America. That Professor Pupin, working as a mathematical physicist at his desk and with pure mathematics, should have developed the theory of the Pupin coil, a theory which with a relatively few experimental proofs subsequently in the laboratory demonstrated its complete truth and made possible this simple, though effective, agent for long distance telephony, is one of the most marvelous tributes to intellectual power and research spirit. That the eminent specialist in the east can give his advice instantly and clearly in a critical case in the west is due to Professor Pupin.

Our universities have long been the fountain heads of the most of American research. Handicapped in many instances by lack of funds, overloaded with instruction and departments undermanned, nevertheless the university professor has struggled for decades and has accomplished even under these most disadvantageous conditions a vast amount of most highly productive research. Nowhere more than in the university is it clearly recognized that it is the duty of educators not simply to draw upon the fund of previously stored knowledge but to make substantial additions thereto. Indeed, a university without a sufficient spirit of research to have a definite plan of contributory activity to progress through research agencies does not deserve the name of university. Every university professor, indeed, every secondary school teacher, should have a modicum of the research spirit.

The interdependence of the university as a research center and the large industrial corporations' research laboratories is very close. Too often the glory and emphasis are laid upon the final outcome of the research. Thus one hears of the perfected motion picture, the X-ray, radio, etc., but hardly a handful of men realize that the motion picture began in the modest laboratory of the physiologist Marey in the outskirts of Paris, studying the physiology of motion, and we too often forget that Wilhelm Roentgen, who made the X-ray pictures possible, was a professor of physics in a German university, as indeed was Hertz, whose investigations form the basis for all radio work.

Obviously the man or woman intellectually well endowed, having received an excellent education, with sufficient means or environment to conduct research unhampered either by anxiety with regard to the cost of living or cost of materials and assistance, has a very great advantage over others who are less fortunate, but the research spirit remains indomitable in the research man. The spirit of research knows no handicaps. We must not forget that Pasteur carried out a long series of most critical experiments when partially paralyzed. In citing a few moments ago the names of some eminent men in connection with the General Electric Company, one name was purposely omitted, for that list contained only living men. But no one can speak of the progress of the General Electric Company without thinking of that strange, misshapen genius, Charles Proteus Steinmetz, whose every word was law and gospel in a General Electric building, a man who was suffering from many physical handicaps and deformities and yet was intellectually gigantic, a man to whom it is said no regular salary was paid. His living needs were small and modest, and the General Electric Company simply gave him "carte blanche" to draw upon them for money as he wanted it. Steinmetz worked for no material gain. He loved his work; he lived for research and he doubtless felt much of the spirit expressed by that great French chemist, Lavoisier, who not long before his tragic end by the guillotine wrote:

> To merit well of humanity and to pay tribute to one's country it is not necessary to take part in brilliant public functions that have to do with the organization and regeneration of empires. The naturalist may also perform patriotic functions in the silence of his laboratory and at his desk; he can hope through his labors to diminish the mass of ills which afflict the human race or to increase its happiness and pleasure; and should he by some new methods which he has opened up prolong the average life of men by years or even by days he can also aspire to the glorious title of benefactor of humanity.

The significance of the research spirit in teaching has been entirely, in my judgment, overlooked. There has been a feeling that research men are members of a closed corporation, that there is a sanctity of the research laboratory, a spirit of the cloistered hall of the ascetic. But this is entirely false. The teacher has the possibilities for not only instilling the spirit of research into the students but likewise of actually accomplishing research. Many of you doubtless are planning to enter teaching, that occupation of which Erasmus once said to Sapidus (a well-known German schoolmaster): "To be a schoolmaster is next to being a king. In the opinion of fools it is a humble task, but in fact it is the noblest of occupations." To-day the teacher is by no means confined to the conventional three R's, reading, writing and arithmetic. The introduction of health studies, of interest in outdoor life, observations with regard to forestry and gardening and a disposition to enter into the "raison d'être"

of things in general has entered pronouncedly into all our college curricula and our school systems.

Indeed no branch of life is devoid of research interest. If I may be pardoned a personal allusion, I have often spoken before medical and scientific societies on the importance of research, and occasionally some one has said "Yes, it is very easy for one whose life is cast in a research environment to speak about the importance of research, but what can the poor country doctor, who has no special apparatus, no large clinic, what can he do to further research?" My answer to that is this. Every country doctor has a stethoscope or at least he certainly has a hand, with which he can count pulse. I have seen an occasion where an entire research of great importance, upon the physiology of children, was absolutely stopped because this simple point was unknown. How long after a meal does the pulse rate of children, which is accelerated by the meal, return to its normal rate? It was necessary to stop one research, begin another and devote several weeks to answering this question first. Any country practitioner could have counted the pulse rate of his children after they had gone to sleep at night and have answered the question in an admirable way.

Of course there are many problems that are of interest and fewer that are of importance. The research spirit perhaps may not invariably distinguish carefully which are important and which are merely of interest, but after all it is not so much the end result as it is the encouragement and the inculcation of the research spirit throughout our entire educational life that will accomplish the greatest ends. Who knows but what before me to-day there may be sitting the future Mayo, the Elihu Thomson, the Marie Curie, the Pupin or the Carrel? With the spirit of research thoroughly imbued in our hearts, no one can dare to predict the practical results of such a spirit in the next two or three decades with the youth of to-day. Every school teacher in the most remote school has the ever-present problem of child psychology. Too little is known about it. Human behavior is almost an uncharted field. There is to-day in the air a plan for a very large research, involving the study of human behavior. Certainly the district school teacher, with a group of children ranging from 4 to 40 years, has problems of the most complex nature continually confronting her. No one needs more knowledge with regard to the psychology of youth, for every child, no matter how stubborn, no matter how seemingly indifferent, has some point of contact, which, if once found, may open up an entire new life vista. The finding of this contact, the opening up and the development of that child has potentialities of the greatest importance. To-day simple rules for psychological tests are available to every school teacher. They have of course greater or less value and one must sound a note of warning, for without intelligent interpretation of the results one can reach the conclusion which was found by one ardent investigator—that all college professors should really be classed as morons. The fact that in yonder building there is a mouse colony contributing to our knowledge of genetics and cancer is of vastly more importance to this institution as a whole, from the educational standpoint and from the spirit that it exemplifies than from the actual contributions to our fund of knowledge, great though they are.

Thus far it has been natural, perhaps too natural, for me to lay emphasis upon research from the standpoint of developing our material knowledge, and yet I feel that I can not overemphasize the *spirit* underlying research as after all being the main thing. What stimulates men and women to research? Many of our industrial organizations have adequately remunerated their scientific research men with substantial rewards that no one would think of denying them. And yet, after all, there are extremely few of the men who have devoted their lives to scientific research who have benefited financially to any great extent. One has but to think of the hundreds, if not thousands, of university professors and research workers scattered throughout this country, some of them right here on this campus, whose contributions make up the vast bulk of the scientific proceedings and communications to our various societies of learning, who are subsisting upon very small and in many cases wholly inadequate sums.

No, it is not correct to state that the urge to research is for gain. I believe it is in large part the *spirit of service*. There is inborn in every man and woman a distinct feeling to do something for some one else. This may be developed or it may be inhibited at an early age. When it is fostered and developed, it usually expands into productive service for mankind, through one of the innumerable channels. When it is inhibited, it usually fails and yet I have already pointed out to you how the true research spirit inborn in a person can overcome almost insuperable obstacles of physical and financial handicaps.

I think that all our research workers, in colleges and elsewhere, primarily are impelled by the feeling and desire to benefit the world. In other words, there is a spirit of service which is a service to both God and man. When a man dies he hopes to leave the world a little better than when he came into it. This may be through the activities of the industrialist who makes available power from unused resources, the engineer who harnesses the forces of nature, the railroad man who opens new country, the poet who unfolds new thoughts and sentiments and the beauty of life in a stimulating phraseology that reaches our listening ears, or the musician who stirs and ennobles the soul with beautiful, uplifting melody or sym-

phonic treatment of themes. Thus the research spirit is by no means confined to materialists and to material things.

It is unfortunate that the absence of the research spirit is more noticed in the phases of life other than those dealing with material developments, for it is sorrowfully true that with the tremendous material advancement of the world in the past 50 or 60 years there has not been a corresponding development of the intellectual powers with regard to the higher things of life. In spite of the decades, indeed centuries of the ever-present example of the noblest in art, there has not been a second Praxiteles. To-day we have no Rembrandts, Raphaels or Vermeers, and there is no modern Shakespeare.

We have no more "Ninth" symphonies or "Unfinished" symphonies and that tinkling tune "Yes, we have no bananas" will not make up for their loss, although the entertainment of those who enjoy that type of so-called music *may be* and unfortunately only too frequently *is* fully satisfactory. It is perhaps surprising that with our increased knowledge of resonance and the elasticity of metals and woods, there is still no substitute for the Stradivarius violin, though we have been inflicted with the saxophone. Here we have immediately a great research problem upon which we may study and reflect and should *act*, as to why is our esthetic, musical, artistic and spiritual life not more progressive? Without development there is stagnation and death, and to avoid this the entrance into our lives at every point of the spirit of research and service is essential, and this service can not be confined solely to the advancement of our material welfare, but its broader aspect must continually be kept in mind.

The recent step of your university in starting the new issue of Maine Studies, the first number of which has just come off the press and which contains a highly creditable discussion of earlier American literature, is most worthy of support from every quarter.

While the commercial returns of research are, as we have seen, oftentimes of great magnitude, the main objective for the research student must invariably be research for *the sake of knowledge*. It has long been accepted that universities must contain research centers, and students sat at the feet of Basil Gildersleeve not in the prospect of immediate rewards or riches but to draw from his fountain of knowledge. Why did students beat upon the doors of the laboratory of Louis Agassiz and why did his son, Alexander Agassiz, after the acquisition of great wealth in business enterprises, devote a large part of his life and fortune to research? The answer is "for knowledge." Certainly those of us who have enjoyed the advantages of a college education must realize that our responsibilities are consequently greatly increased, and we must see to it, for it will be through our efforts, if through any one's, that the research spirit, which is inherent in every college professor, is not too much inhibited or restricted by disadvantageous conditions. We surely can all support the research spirit and the necessity for research centers in our universities, and I firmly believe we should carry this further and emphasize the importance of the research spirit in our high schools and grammar and district schools. Bring this once effectively into play and the returns will be enormous. Obviously we can not alter the entire educational system of the state of Maine by attempting to add to an engorged curriculum or to overburdened teachers. Research above everything is not upsetting existing order. It is invariably to better the order. The old injunction "to prove all things and to hold fast that which is good" again breathes of the finest types of research spirit.

But one of the most important, if not the most important factor and result of the research spirit is its inherent tendency to develop initiative. This is of enormous educational value. In modern life there is a spirit of advance, the spirit of expectation, the spirit of hopefulness coupled with an intensity of purpose that is at times almost terrific. If this can be so directed as to develop to the fullest degree the initiative of every man, woman and child, we have the spirit of research filtering into daily life in ideal manner.

When the college graduate leaves the university halls and goes out into the world to make his way, he is immediately confronted with a situation that is strange and to which he must rapidly adjust himself. In just so far as he has been compelled to adjust himself to new environments successfully in his university career, just so successfully will he adjust himself to his new environments in his business or educational or professional career. Successful research is based wholly upon the adjustment to a new condition, a new environment. "The Occasion Instant." "Decision Difficult." Hence, personally, I have always looked with greatest favor upon all phases of academic life that necessitated such adjustments. For example, what could be more ideal for such training than the fine-grained, high principled college athlete entering into his competition clean as a hound's tooth, with the spirit to win, but with a game spirit if he loses? He adjusts himself to all possible new situations and at every period of the mile run, at every moment of the football or baseball game, the situation changes and new adjustment is necessary. Successful and rapid adjustment to this situation is the largest factor in success. If under these conditions he is fortunate enough to come out and win, no one will deny him his good fortune.

There can only be one winner, and there are lots of losers. I think that a good paraphrase of the proverb that "a good name is rather to be chosen than great riches" would be "a good loser is rather to be greeted than a vain-glorious winner." There is something fine in seeing a man take defeat in a good spirit.

We have, then, in good, clean competition, in sports, an ideal illustration of one of the fundamentals required for the best development of the research spirit, that is, the quick, successful adjustment to a new situation and environment. One of the most interesting and at the same time most important illustrations of this was developed in the late war, when the call came for doctors to go to Europe in the field. Who were the most successful doctors in the emergencies on the European battlefields? Not the great specialists of the large city, not the man whose practice was confined to office and consultations, but as a matter of fact, the country doctor showed up better than anybody else, for no one has more often to adjust himself to a new situation and an emergency than has the country doctor. The resourcefulness shown by the average country practitioner is marvelous. Could this only be directed into some research channels, the country doctor would surpass many of his hand-picked, city-bred colleagues.

Finally, we must immediately get over the idea that practical, successful research is confined to large institutions, for only too frequently does the individual amateur scientist through well-planned studies make important discoveries. The "gentleman farmer" often makes very considerable advances to our knowledge of agriculture. The importance and dignity of agriculture as a phase of economic and, indeed, cultural life, is only beginning to be felt. On the great seal of the U. S. Department of Agriculture it is stated that "agriculture is the foundation of manufacture and commerce." The great advances for the sustenance of man, his food supply, without which he can not live, the utilization of material hitherto impossible for human consumption, the scientific breeding, feeding and development of domestic animals, all are now being attacked with one of the finest organizations of research workers existent in the entire world. The United States may well be proud of its marvelous system of agricultural experiment stations, and whatever else the legislators in Washington have done, past and present, one must be thankful that they were once farsighted enough to provide large, regular appropriations such as the Hatch and Adams funds for agricultural research. Furthermore, they were wise enough to stipulate that these funds be used for research purposes only.

This idea of agricultural research had its inception years ago in Germany, where they early recognized the fundamental importance that agriculture must play in the economic life of the nation. While their agriculture had developed enormously, it could not of itself save them in their great crisis, but while their economic and sociological reverses are making heavy inroads upon their population and the health of their children, their scientific agriculture and their scientific puericulture can be but the admiration of every one who has had an opportunity to examine them.

To consider how research permeates into every field of human endeavor would be altogether too time-consuming, and we must be satisfied with accentuating the fact that without research there is no life, for to revert to the primitive man would, judged from our present standards, not be life, it would be mere existence. In every way, therefore, it is incumbent upon us as citizens of this country, as educated men and women, to give our strongest support to all educational movements which involve the development of the research spirit. In so doing not only will we have intellectual results of the most striking nature, but we have the added, if needed, incentive of the possibilities of considerable material reward and financial profit. But far above this is the inculcation of a broad and liberal spirit of progress and recognition of a necessity for adaptation to environment, to live with our neighbors, to adjust ourselves to situations as they arise from day to day, and to carry this to national existence, for we must exist with other peoples.

Even in the midst of wars we find research men ready to receive their fellow research men, even though the statesman and politician be at loggerheads. One can do no better than to quote the words of Sir Humphry Davy. In 1807 a French delegation went to London to present a medal to Sir Humphry Davy, while war between the two countries was in progress, and Davy, in receiving the medal, said: "Science knows no country. If the two countries or governments are at war, the men of science are not. That would indeed be a civil war of the worst description. We should rather through the instrumentality of men of science soften the asperities of national hostility." It was my great privilege but a few months ago to witness a similar incident, which I feel should put to shame many of us in our mental attitudes toward our former enemies. Ten months ago a great international Congress of Physiologists, including of course a large number of medical men, was assembled at Edinburgh. The committee, in preparing the invitation for this gathering, were at first in doubt as to whether the scientists of the Central Powers should be invited or not. The British Physiological Society, with characteristic British generosity, voted unanimously, as I under-

stand it, to have this invitation extended. The invitation was sent, but unfortunately, owing to the rate of exchange and the impoverishment of the nation, the Germans could not accept. One of the German professors told me it would cost him three fourths of his yearly salary to go to Edinburgh and return. In Edinburgh there was a group of public-spirited citizens who, casting aside all recollections of the horrors and sufferings of the recent war, men and women who had, I think in every instance, lost some immediate member of the family, as a result of the war, backed up this invitation to the Germans by sending a personal invitation to each German to be their house guest while in Edinburgh and furthermore a subscription was raised and three English pounds sent to each man.

Twenty-five came. I talked with many of them. I never saw a greater sense of deep appreciation exhibited by a group of men in my life. They told me they had been taken into the households of these people, had been given every courtesy, had been fed as they had not been fed in years, and I am sure that every one of these twenty-five men went back to their home land, to their classes, lecture halls and their students with warmer and deeper feelings for their former enemies than ever before, feelings that must through educational channels permeate deeply into civilian life. If these people in Edinburgh who had suffered so terribly as a result of this great conflict had breadth of human spirit enough to open their arms, take to their bosoms, into their houses, and have them break bread at their tables these representatives of their former enemies, forgetting all past offences and worshiping conjointly with these people at the shrine of that great science, physiology, how can we, thousands of miles away from the source of conflict, scarcely touched by the terrors of war, how can we, I say, consistently harbor in our hearts embittered feelings against a struggling people, struggling against a horrible self-inflicted blow. The magnanimity and humility and brotherly love exhibited at this great meeting of scientists showed me as never before that research knows no country. All are working for the best and for the advancement of mankind, and the infusion of the research spirit throughout our entire educational system can not, in my judgment, make except for a wider-visioned, better and more tolerant nation.

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WHAT IS THE LARGER MEANING OF THE VITAMINE TYPE OF ACTION?

So recent, so startling and, in a way, so bewildering are the discoveries concerning substances which, like vitamines and hormones, produce such astonishing results in proportion to the quantities involved that nobody, not even those to whom belongs the credit for making the discoveries, seems to have had time to consider very much how the substances tally with others much better known in their relation to the phenomena of living beings.

If we view the apparently certain dependence on vitaminic action of metabolism and of conception in sexual reproduction, two of the most basic of all life processes, in the light of the universally held tenet that all such processes involve the transformation of matter and energy, an extremely far-reaching question easily formulates itself: Does such dependence mean that organisms have no power to utilize physiologically the potential energies either of the substances of their own bodies or of the foreign substances ingested by them, except through the activation of these energies by substances more or less of the vitaminic type or by changes of external condition of some kind?

It certainly looks as though a conclusion of this sort is being forced upon us. But if such is the case it is hardly possible to avoid pushing the question on from the realm of physiology to that of psychology. Within the realm of psychology, or better of psychobiology, the phenomenon of stimulus and response, definitive for the whole of life, first presents itself for consideration alongside the type of action in question. And it is important to note that stimulus and response almost certainly constitute fundamentally one of those inseparable couplets, like time and space, which we are coming to see enter largely into the make-up of the universe.

Our question then forges ahead inevitably until it covers the whole range of phenomena from those connected with the reflex arc fundamental to much of animal life, to those connected with the neural, muscular and glandular systems as represented in the highest brute and human animals.

One close-at-hand possible nexus between the stimulus and response type of phenomenon and the vitamine type is furnished by the conditioned nature of the beginning of individual development from the germinal stage of all organisms that exist part of the time in this stage.

The evidence is now overwhelming that the germs of no organisms whatever are able to start by their own inherited energies on their developmental careers. Their potentialities must be activated by something external to themselves either by contacts with other bodies or by changes of condition of the surrounding bodies. The numberless researches of the modern period on fertilization point unequivocally to this conclusion. The major point of the whole matter here is more the powerlessness of latent energies to

actualize themselves than what particular activating influences may turn the trick.

How far, now, does this sort of thing hold in living nature? Is it possible that all organic stimulus without exception comes under this principle? Indeed may it not be that exactly what we mean by such a stimulus is an activation of potential energies of some kind possessed by the stimulated organism? It would undoubtedly be permissible to look, for example, on the energies of all muscles and glands, so far as these organs approximate complete quiescence in the living organism, as being in a state of potentiality and requiring their appropriate stimuli (typically nervous) to change them to the state of actuality.

And from this standpoint while heredity is not, indeed, a "mere abstraction," *i.e.,* something that "does not actually exist," as a few thoughtful biologists have pronounced it to be, yet it is a "mere potentiality." And since, like all other potentialities, it is powerless to actualize itself, the whole long series of activating stimuli, without which there is no development at all, stands forth as external or environic influences of great positiveness and importance. According to the questioning here being indulged in, it would seem to be quite wrong to assume, as we are inclined to, that the initial stimulus of fertilization is the only one necessary to accomplish the development of the individual.

Again, if this dependence of life processes on the activation of potentialities by external agencies is really as far-reaching as all signs indicate, the question of its meaning for the processes we call mental, psychic, spiritual, become urgent and almost staggering. For instance, what possibilities are held before us of removing finally all doubts as to the scope and real place of sense experience in human life? For one thing the obviously correlative facts of the complete immobility of the nervous mechanism and the very special and highly efficient mobility of the muscular mechanism strongly suggest that the former somehow embodies organic energy in the latent state, so far as animal activity is concerned, while the latter presents it in the active state. And specially significant in connection with the suggestion here made is the strong tendency in present-day psychobiology to look upon the two systems, the nervous and the muscular, as not really two systems, separate and independent, but as one system, the neuro-muscular, with two distinct parts.

Having pushed our questioning thus far with gleams of light all the way we are encouraged to go still further and ask whether the problem of consciousness itself stands any chance of being illuminated by the potentiality-actuality-activation principle.

Now any one who has given this problem much attention is pretty likely to be reminded by this extension of our question of the theory propounded a few years ago by W. P. Montague that consciousness *is* energy in a latent state.

So far as I know there has never been anything presented which would correspond in the Montague theory to the activation phase everywhere implied in our questioning. But so far as it goes this theory is highly interesting from the standpoint of this note, especially if organic potentiality be not conceived as absolute inactivity but only as motor and translatory inactivity. Molecular, intracellular activity in any degree might be assumed and thus would fall in well with the high rate of metabolism observed in the brain.

The subject brought before us by these reflections is so vast that a communication like this can, of course, be nothing more than the barest touch upon its hem.

Even so, perhaps enough has been said to justify an attempted definition of a living animal creature that is rather strikingly different from the usual run of these attempts: Such a creature is a vastly complex organization of substances some of whose energies are always in the active state while others are in the latent state, the organization being such as to enable the creature constantly to alter more or less the relation between the two states of its energies in accordance with its needs, present and prospective; being able, in other words, to respond adaptively to the stimuli to which it is subject.

Nor is the questioning upon which we are launched able to find a permanent resting-place on the high road from psychobiology to philosophy. For, be it noticed, if the "stimulus-response polarity" plays the basic part in all life that is strongly intimated, then are we humans part and parcel of the system of nature not only through the bonds of the substances and energies by which we act at all, but also through the bonds by which we act consciously and intelligently. And since the source of the stimuli which condition our conscious and intelligent lives is limitless in extent, so far as we know, literally and not figuratively do we "live, move and have our finite being" in a universe that appears to be infinite in both space and time.

Wm. E. Ritter

Yacht "Ohio"
July 21, 1924

SCIENTIFIC EVENTS

A SOCIETY TO PROMOTE CULTURAL RELATIONS BETWEEN ENGLAND AND RUSSIA

A society for Cultural Relations between the Peoples of the British Commonwealth and the Union

of Socialist Soviet Republics was founded recently in London. The objects of the society are: (1) To collect and diffuse information in both countries on developments in science, education, philosophy, art, literature and social and economic life; (2) to organize lectures and an interchange of lecturers, conferences, exhibitions, etc., and to arrange for the publication and translation of papers and books; (3) to provide opportunities for social intercourse; (4) to take any action deemed desirable to forward the intellectual and technical progress of both peoples. This we learn from *Nature* from which we print the following:

Russia has unfortunately been cut off from all other civilized countries for about ten years, owing to the war and the revolution which followed it. Only in this year has it been possible to break down some of the wall separating Russia from other peoples. Through the crevices Europe begins to see that, in spite of the most difficult conditions prevailing in science and art, the great spirit of Russia is still alive and even active. Hunger, shortage of necessary technical materials, apparatus and books, the necessity of working in rooms and laboratories where the temperature in winter was near freezing-point, prosecution by the government—all this has not killed the spirit of Russia. The attempts of the government to proletarianize science and art have not been very successful for a simple reason, namely, there is only one truth, the same for proletarians and bourgeois, the desire for which is that peculiar feature which distinguishes a man from an animal. For Russians the breaking down of the wall surrounding their country has become much more important than for countries which are outside this wall: the development of western science, art, literature, philosophy and social life, which is free and not "controlled" by government and has proceeded under normal conditions of life, has resulted in remarkable progress. There is no need to point out how vital the knowledge of this progress is to Russia. From this point of view, it is necessary only to wish all success to this new society, provided it does not become an official organization, but remains free from any official control and concerns itself only with the promotion of friendly relations between the intellectual representatives of both countries.

RESURVEY OF NIHOA AND NECKER ISLANDS

DURING 1923 the Tanager Expedition, under the joint auspices of the United States Navy, the U. S. Biological Survey and the Bernice P. Bishop Museum, made a scientific survey of the chain of islands extending from Hawaii, 1,000 miles northwestward to Ocean Island. A corps of nine scientists, assisted by experienced collectors and by the officers and crew of the U. S. S. *Tanager,* carried on investigations in marine zoology, botany, entomology, ornithology and geology for five months. Somewhat unexpectedly ruins of ancient settlements were found on the islands of Nihoa and Necker. These two islands are eroded remnants of volcanic masses, cliff-bound and without water. On them a landing party made collections and maps, but had neither the time nor the facilities for an exhaustive study of the archeological remains.

During July of the present year, the United States Navy again provided the *Tanager* and with a selected navy personnel and a group of scientists from the Bishop Museum, under the direction of Professor Harold S. Palmer, the ship returned to Nihoa and Necker equipped for making topographic maps, sketches and photographs showing the location and character of the walls, house platforms, terraced fields and burial grounds. With considerable difficulty, land camps were established and the surfaces of the islands cleared of brush, revealing ruins favorably placed for study.

As compiled by Kenneth P. Emory, ethnologist of the Bishop Museum staff, the Nihoa maps show fifty structures within an area of about 130 acres—house platforms, temple sites, garden terraces; the Necker maps show only ruins of places used for religious purposes. The collections from these islands include stone bowls, stone idols, adzes, hammerstones and other artifacts, and skeletal material from burial caves. Although Nihoa Island is only 160 miles from Kauai, the stone structures and the skeletons show forms not common to the inhabited islands of the Hawaiian Archipelago.

FIRST PAN-PACIFIC FOOD CONSERVATION CONFERENCE

THE first Pan-Pacific Food Conservation Conference met at Honolulu, from July 31 to August 14, 1924, under the able chairmanship of Dr. L. O. Howard, chief of the Bureau of Entomology of the United States Department of Agriculture. Ninety-five of the delegates came to Hawaii for these meetings—thirty-eight from mainland United States, fifty-five from other Pacific countries, and two from the West Indies. Twelve duly constituted delegates from Hawaii and thirty-six residents of Hawaii participated in the meetings which were also attended by a considerable number of local laymen. Strong delegations were sent from French Indo-China, Japan and New South Wales. Altogether fourteen Pacific countries were represented by about a hundred and forty technical men and women.

The conference, which was the fifth designed for promoting the mutual understanding by peoples of the countries around the Pacific of one another's problems, was called by and held under the auspices of the Pan-Pacific Union. A very important result of the conference, and one difficult to measure, was the

broadening due to close contact between delegates from many regions. An appreciation was obtained by many of problems which are not widely realized though of vital importance to their immediate localities.

The conference was organized in seven sections, the most active of which were devoted to (a) the sugar-cane industry, (b) fisheries, marine biology and oceanography, (c) plant protection through quarantine and researches in entomology and pathology and (d) food-crop production and improvement. As a result of the deliberations of the section on the sugar-cane industry, there was tentatively organized an international association of men interested in the sugar-cane industry, which it is hoped will meet in Havana in 1927. The other sections have also provided continuation committees.

At the final sessions thirty-three resolutions were adopted. Three resolutions relate to the sugar industry, six to fisheries, four to plant protection, one to animal industry, four to food crops, three to marketing problems and the rest are of a more general nature. Classifying the resolutions on a different basis, three refer to the work of the Pan-Pacific Science Congress to be held in Japan in the autumn of 1926, six to protection of food resources by international treaties and agreements and twelve recommend more or less specific programs for future research.

The committtee on publication appointed by the conference plans to publish a report of the proceedings which will include abstracts of the papers transmitted, list of delegates and the like. It is expected that many of the papers will be published in full in journals devoted to special fields of science.

HAROLD S. PALMER,
Secretary of the Conference

COOPERATION IN SEISMOLOGY

AN agreement has been reached to promote seismological research in both scientific and practical lines between the Carnegie Institution of Washington, through its advisory committee in seismology, and the Seismological Society of America. The first-named is a research organization, which pursues the policy of publishing its results in any particular journal that will reach the largest number of readers interested in a given subject. The second is a society dependent on its members for support and engaged in publishing a journal (*Bulletin* of the Seismological Society of America), which is designed to form a means of communication among seismologists and to serve as a medium of education for the general public in matters relating to earthquakes and allied phenomena. It is obvious that these two organizations may advantageously cooperate.

The advisory committee in seismology was appointed by the institution four years ago with the specific purpose of organizing investigation in the field of seismology. After considering the extent and character of the field, the committee recommended "taking up at the outset the pressing problem offered by the West Coast region of the United States, where earth-movements in considerable variety occur and so little is known about them that they constitute a tangible menace to large engineering and other development enterprises and sometimes to human life." (Report of the Chairman for 1921.)

If this selection of a province seems geographically limited the fruitfulness of the region in problems may be indicated by a further quotation from the report cited, bearing on the organizations drawn into the work. The report continues:

"It was recommended that the Institution invite the participation of a number of agencies, through the cooperation of which an adequately comprehensive attack might be inaugurated and competent conclusions assured." Accordingly the Ukiah and Lick Observatories were invited "to continue and extend their observations of latitude for the purpose of establishing (or disproving) a northward crustal creep or drift, which had been indicated by earlier observations." The U. S. Coast and Geodetic Survey was invited to resurvey and extend "its system of primary triangulation and precise levels until no considerable area within the various zones of movement in California can suffer displacement without the possibility of establishing its direction and magnitude." The U. S. Geological Survey, in collaboration with the California universities and geological societies, was asked to "organize geological studies of the regions in which the more active faults occur. Several organizations "were invited to aid in the development of instruments more suitable than any now in use for recording and analyzing local slips and tremors. And finally, the Navy Department undertook deep-sea soundings off the west coast of California to establish the precise location of the continental shelf and any conspicuous fault scarps adjacent to the land areas in which active faults are found.

Without exception the initiative of the advisory committee was welcomed by the organizations invited to participate and important results have already been reached. Among the more definite accomplishments we may mention the Fault Map of California, published by the Seismological Society, the Bathymetric Chart of the Continental Shelf from San Francisco to Point Descanso, published by the U. S. Hydrographic Office, a new primary triangulation of the entire coast region south of San Francisco by the U. S. Coast and Geodetic Survey and the successful development of a new type of torsion seismometer of low first cost and general application by Messrs. J. A. Anderson and H. O. Wood, working in the laboratories of the Mt. Wilson Observatory at Pasadena.

The influence of the advisory committee in promoting cooperation is now extended to the Seismological Society of America. That society, organized in 1906 and publishing since 1911, has for its objects the advancement of seismological research and the promotion of human security against earthquakes and earthquake fires. It has carried on its work with slender means, with a membership of about four hundred, including interested laymen as well as seismologists, widely distributed in all the continents. Recently its membership has increased by more than fifty per cent., and it seeks to increase it still further in order better to serve its objects. The agreement with the advisory committee in seismology provides that the latter shall assist, temporarily, in the publication of the *Bulletin* of the society by meeting the cost of publishing specific articles which the society could not otherwise undertake.

The guarantee of this financial support is of such a nature that the Seismological Society may and does extend an invitation to workers in the field of seismology and related zones of research to use the *Bulletin* as a means of communication with fellow workers in all lands. In considering the scope of the field of seismology and related zones of research within which it may advantageously serve its scientific circle, the *Bulletin* will lean toward a liberal interpretation, with due regard for the established journals in meteorology, chemistry and physics. Its interest centers in the dynamics of the earth, but extends to allied researches which may throw light upon that comprehensive field of activity.

Another phase of the *Bulletin's* interest comprehends the practical side of earthquake studies. The world-wide occurrence of earthquakes means that there is world-wide experience of their effects, acquired at the cost of enormous values destroyed and great loss of life, but so scattered, ignored or suppressed that it is ineffective to serve humanity at large. The records of that experience await assembling, discussion and interpretation for the benefit of communities in all trembling lands.

Furthermore, there is great need of education of the intelligent public to take earthquakes out of the realm of astrology and rob them of that mystery which is one of their most potent attributes for mischief. Articles dealing with the facts of earthquake activity in relation to human affairs, addressed to men of affairs, in language intelligible to the educated reader will also be welcomed by the *Bulletin.*

Correspondence with the chairman of the Committee on Publication, Professor S. D. Townley, Stanford University, California, is invited from all who may be interested, either in publishing the results of seismologic studies or becoming members of the society. Articles intended for publication may be written in English, French, German or Italian. Publication will be in English, but if the foreign author should wish to supply an abstract in his own tongue, it may be printed in any one of those languages.

ARTHUR L. DAY, *Chairman*
Advisory Committee on Seismology, Carnegie Institution of Washington,
BAILEY WILLIS, *President,*
Seismological Society of America

SCIENTIFIC NOTES AND NEWS

AT the conclusion of the meetings of the French Association for the Advancement of Science, the University of Liége conferred honorary degrees on M. Raymond Poincaré; Dr. Rigaud, director of the Paris Radium Institute; Dr. Lacroix, secretary of the Paris Academy of Sciences; Dr. Paul Sabatier, professor of chemistry at Toulouse; Dr. Marcellin Boule, professor of paleontology at the Natural History Museum, Paris; Dr. Henri L. Le Chatelier, professor of chemistry at Paris; Dr. Charles Barrois, professor of geology and mineralogy at Lille; Dr. Paul Shorey, professor of Greek at the University of Chicago.

AT a special convocation of the University of Toronto, held on August 13, on the occasion of the meeting of the British Association for the Advancement of Science, the degree of doctor of science, *honoris causa,* was conferred on Sir David Bruce, president of the British Association; Sir Ernest Rutherford, retiring president, Cavendish professor of physics at the University of Cambridge; Sir John Russell, director of the Rothamsted Experimental Station, and Sir Charles Parsons, chairman of the Parsons Marine Turbine Co., London.

THE honorory degree of doctor of philosophy has been conferred, by the University of Bonn, on Dr. Frank Springer, of the National Museum.

DR. JOSÉ CASARES Y GIL, dean of the faculty of pharmacy at Madrid, has had an honorary degree conferred on him by the University of Munich.

PROFESSOR SALVATOR PINCHERLE, professor of infinitesimal calculus at the University of Bologna, has been elected president of the International Mathematical Union.

DR. M. JEAN CAMUS, professor of physiology at the Paris Medical School, has been elected a member of the French Academy of Medicine.

DR. G. HABERLANDT, professor of botany at the University of Berlin, has been elected a foreign member of the Royal Swedish Academy of Sciences.

THE director of the U. S. Geological Survey rep-

resented the Secretary of the Interior at the World Power Conference, held in London, from June 28 to July 12. The Geological Survey was represented by John C. Hoyt.

PROFESSOR ALAN W. C. MENZIES, of Princeton University, has been appointed as delegate from the Royal Society of Edinburgh to the Franklin Institute on the occasion of its centenary in September.

DR. J. E. MILLS has been appointed chief chemist in charge of the research work of the Chemical Warfare Service.

DR. G. F. LOUGHLIN has been appointed geologist in charge of the section of metalliferous deposits of the U. S. Geological Survey to fill the vacancy caused by the resignation of Dr. F. L. Ransome. F. J. Katz has been made geologist in charge of the division of mineral resources, the position vacated by Mr. Loughlin.

PROFESSOR MAX A. MCCALL, formerly superintendent of the Adams Branch Experiment Station, Lind, Washington, and more recently in the division of agronomy of the Washington Agricultural Experiment Station at Pullman, has been appointed agronomist in the office of cereal investigations of the Bureau of Plant Industry, U. S. Department of Agriculture.

DR. T. S. TAYLOR, since 1917 in charge of Insulation Research with the Westinghouse Electric and Manufacturing Company, has joined the research department of the Bakelite Corporation, and will have his headquarters at Bloomfield, New Jersey, at the new research laboratory now in process of construction.

SCIENCE Service, Washington, D. C., announces the addition to its staff of Dr. Frank E. A. Thone and Dr. James P. Kelley. Dr. Thone was formerly assistant at the University of Chicago and Johns Hopkins University, as well as assistant professor of botany at the University of Florida. He will direct the *Daily Science News Bulletin* which Science Service furnishes to newspapers. Dr. Kelly, who holds degrees from Princeton and Columbia, goes to Science Service from the Pennsylvania State College. He was for a time assistant editor of *Botanical Abstracts*. He will devote particular attention to the half-page science features.

DR. EUGENE C. TIMS has been appointed assistant pathologist at the Louisiana Agricultural Experiment Station, Baton Rouge, La.

PINGJAN TSIANG has been appointed director of the observatory at Tsingtao, which has been handed over by Japan to China.

GEORGE C. MARTIN, geologist in the Alaskan Branch of the Geological Survey, resigned on July 1.

DR. W. A. TARR, of the University of Missouri, will spend the coming year in Europe on sabbatical leave of absence. He expects to carry on his studies of chrit, stylolites and related features of sedimentary rocks, as well as visit the more important mineral deposits. A part of the year will be spent in the laboratories of Dr. R. H. Rastall, at Cambridge University.

THE Paris correspondent of the *Journal* of the American Medical Association writes that at Saint Christophe, his native city, a monument was recently unveiled in memory of Professor Raphael Blanchard, who died in 1919. Addresses were delivered by Dr. Doléris, president of the Academy of Medicine; Professor H. Roger, dean of the faculty of medicine of Paris; Professor Lapersonne, and others. The speakers referred to the progress that Blanchard had brought about in parasitology; the part that he had played in the establishment of the Institute of Colonial Medicine and in the Société de Zoologie, which he helped to found and which he served for twenty-two years as general secretary, and in the Société d'Histoire de la Médicine, of which he was also one of the founders.

DR. BERTRAM WELTON SIPPY, professor of medicine in Rush Medical College and the University of Chicago, well known for his work on the diseases of the gastro-intestinal tract, died on August 15 aged fifty-six years.

DR. JOSEPH ELLIOT GILPIN, professor of chemistry at the Johns Hopkins University, has died aged fifty-six years.

DR. OLIVER W. HUNTINGTON, formerly instructor of mineralogy at Harvard University, has died, aged sixty-six years.

SIR WILLIAM MADOCK BAYLISS, professor of general physiology in University College, London, died on August 27 at the age of sixty-four years.

PROFESSOR JULIUS WERTHEIMER, professor of applied chemistry and dean of the faculty of engineering at the University of Bristol, died on August 9, aged sixty-four years.

DR. JOSEF HERZIG, emeritus professor of chemistry at Vienna, and member of the Vienna Academy of Sciences, has died at the age of seventy years.

DR. EDOARDO BASSINI, senator and emeritus professor of surgery at the University of Padua, has died at the age of eighty years.

THE eighty-eighth annual meeting of the Association of German Scientific Men and Physicians opens

on September 24, in connection with a scientific exhibit at Innisbruck.

MORE than 1,000 members from universities and industrial enterprises in every state will attend the fall meeting of the American Chemical Society to be held in Ithaca from September 8 to 13. The general meeting at which the foreign chemists will speak will be held on Tuesday, September 9, at 9.30 A. M., in Bailey Hall, Dr. Livingston Farrand, president of Cornell University, presiding. A response to addresses of welcome will be made by Dr. Leo Hendrik Baekeland, of New York, president of the American Chemical Society and professor of chemical engineering in Columbia University. On the afternoon of this day the visiting chemists will inspect the Baker Laboratory, the gift of George F. Baker, of New York, under the direction of Dr. L. M. Dennis, head of the Cornell Department of Chemistry.

AT the seventy-second annual meeting of the American Pharmaceutical Association being held in Buffalo, Charles W. Holten, of Newark, N. J., was elected president; William B. Day, of Chicago, was reelected secretary, and E. F. Keyyl, of Baltimore, was reelected treasurer. Louis Emanuel, of Pittsburgh, was designated honorary president for 1924–1925.

THE third national symposium on colloid chemistry will be held at the University of Minnesota in June, 1925.

THE Viceroy of India has sent a donation of Rs. 1,000 and the Maharaja of Nepal a donation of Rs. 1,500 towards the funds being collected for the foundation of the Ross Institute and Hospital for Tropical Diseases.

AT the University of London research grants out of the Dixon Fund for the year 1924–25 have been made as follows: £50 for research on the physiological factors governing the proportions of sexes in mammals to Alan Sterling Parkes (Institute of Physiology, University College); £50 to Eric Arthur Spaul, Ph.D., to continue experiments with the anterior lobe pituitary gland, and to gain further knowledge of the properties of the active principles of this portion of the gland and also its biochemical properties (Zoological Laboratory, Birkbeck College); £50 to Florence Mary Wood, for chemicals and apparatus in connection with research upon the chemical nature of the cellulose membrane; £20 to Muriel Bond, M.Sc., for research into the dietetic factors influencing reproduction (London School of Medicine for Women).

THE Vienna correspondent of the *Journal* of the American Medical Association writes that the new university building, which had been commenced in 1914, but which could not be completed during the war, was opened on June 28. The new building succeeds the old one, which dates back to the sixteenth century, and which was antiquated. The hygienic arrangements, and the accommodations for laboratory work and for other research were sorely behind the requirements of our time. There are accommodations for administration as well as for all studies except the purely medical. The latter have to be pursued at the bedside in the old clinical hospitals. The costs of the new building were defrayed by the state, only a small percentage of the actual expenditure being contributed by the municipal and county authorities.

EIGHT new mountains have been found and ascended and the hitherto unknown Cariboo Range in British Columbia definitely located by Professor Rollin T. Chamberlin, of the University of Chicago Department of Geology, and Allen Carpe, a New York engineer. One of the peaks, yet unnamed, ranks among the highest in the Canadian Northwest. In addition to the discovery and ascent of the great glacier peaks, Chamberlin and Carpe have located the headwaters of the Thompson and Canoe rivers, the latter of which follows the Rocky Mountain trench to the Columbia River. They are the first white men ever to note the glacial sources of the two mountain streams.

ACCORDING to the *Journal* of the American Medical Association, the advisory committee on the education of sanitarians and the future of public health in the United States, of the U. S. Public Health Service, met in Washington, D. C., on July 24. Measures were discussed for providing supplemental academic training for health officers, sanitary engineers, statisticians, public health nurses, laboratory specialists, oral hygienists and other types of sanitarians now employed. According to preliminary reports presented at the meeting, several hundred persons have been in attendance this year at four public health summer schools—those conducted by Columbia University, the University of California, the State University of Iowa and the University of Michigan. Inquiries received last winter, however, indicate that a greater number wish to secure further academic training than appear to have been able to leave their work for six or eight weeks summer school. It is the hope of the Public Health Service that the universities of the country with which "Class A" medical schools are affiliated may provide in the future three kinds of facilities for the further education of sanitarians now employed. First, it is hoped that at least a few schools will be able to offer intensive courses providing for the continuous study of a single subject for the period of a month or more. Such courses are offered by the School of Public Health of Harvard University and provide an opportunity for training which requires that a sanitarian absent himself from his work for only a month at a time.

Secondly, it is recommended that universities and medical schools offer one or more courses of study with two or three hour periods once or twice a week at a time of day which will make possible the attendance of persons employed by various kinds of health agencies. Courses are now offered, of course, by a number of medical schools which would be of great value to sanitarians now employed were the availability of these courses brought to their attention. Finally, it is expected as a result of the interest demonstrated by sanitarians this year, that Columbia University, the University of Michigan and possibly two or three other institutions will conduct in 1925 public health summer schools of a similar nature.

THE *Journal* of the American Medical Association states that the minister of labor has published the vital statistics for France during the first three months of 1923 and for the corresponding period in 1924: During the first quarter, the number of marriages was nearly 10 per cent. higher than for the corresponding period in 1923. The number of living births has remained about stationary; also infant mortality. The total number of deaths, however, has risen from 190,036 to 219,045, but the same thing is true of other countries. In England, for example, the number of deaths has risen from 124,720, during the first quarter of 1923, to 160,279 for the first three months of 1924. Nevertheless, the demographic situation of France during the first quarter of the current year was deplorable, since it resulted in an excess of deaths over births of 24,039, as compared with an excess of births over deaths of 6,069 in 1923.

UNIVERSITY AND EDUCATIONAL NOTES

THE College of the Pacific is now moving from San Jose, California, to Stockton, California, where seven new buildings are being completed at a cost of $750,000. The science building will be well equipped for physics, chemistry and biology.

THE Miners' Welfare Committee, England, has made a grant of £2,250 toward the equipment of the mining department of the Royal Technical College, Glasgow.

MR. BLUMENTHAL, of New York, as further evidence of his interest in French universities, has presented to the Sorbonne, Paris, a gift of 250,000 francs.

PROFESSOR A. F. GREAVES-WALKER, ceramic engineer, vice-president and director of the Stevens Bros. Co., Ga., has been appointed director of the new department of ceramic engineering to be established at the North Carolina State College during the coming school year.

DR. J. A. ELDRIDGE, of the General Electric Company and formerly of the University of Wisconsin, has been appointed an associate professor of physics at the University of Iowa.

DR. E. F. PHILLIPS, who has been in charge of the Beekeeping Investigations of the Bureau of Entomology for the past nineteen years, has accepted a professorship in apiculture at the New York State College of Agriculture, at Cornell University, and will begin his work there about October 1.

AT Barnard College, Columbia University, Dr. Louis H. Gregory has been promoted to associate professor of zoology, and Miss Grace Sangford to assistant professor of physics.

DR. NICHOLAS M. ALTER, instructor of medicine at the University of Michigan Medical School, has been appointed professor of pathology at the University of Colorado.

DR. GEORGE B. ROTH, assistant professor of pharmacology in Western Reserve University, has been appointed professor of physiology and pharmacology in the George Washington University Medical School, Washington, D. C.

DR. HERBERT W. ROGERS, assistant professor of psychology at the University of Minnesota, has been appointed assistant professor and director of the laboratory of psychology at Lafayette College to fill the vacancy created by the resignation of Dr. Gilliland, who goes to Northwestern University.

PROFESSOR S. CHAPMAN, professor of applied mathematics at the University of Manchester, has been appointed professor of mathematics at the Imperial College of Science, South Kensington.

DR. ALFRED KUHN, professor of zoology at the University of Göttingen, has been appointed professor of zoology and comparative anatomy at Munich, to take the place of Professor R. V. Hertwig, who has resigned.

DISCUSSION AND CORRESPONDENCE

NOTE ON THE RELATIVITY MOTION OF MERCURY

ACCORDING to the formulas of relativity as given by Eddington the perihelion of a planet's orbit moves forward in each revolution by an amount,

$$6\pi \frac{m}{p},$$

where p is the parameter of the orbit and m, *"the gravitational mass of the sun is approximately 1.5 km."*

With this value of m, the motion of Mercury's apse-line is computed by the relativists as being 43

seconds of arc per century. But this value of m, namely 1.50 kms., depends entirely upon the choice of the fundamental units of length and time. For, in celestial dynamics, mass is a derived unit and involves the units of time and distance. This relation is well known and is given by Eddington in the form:

$$m = v^2 r,$$

where r is the distance of any planet from the sun and v is the velocity of the planet in its orbit.

This expression for the mass of the sun will become linear when v is expressed as the ratio of velocities, is expressed in terms of some arbitrary unit of velocity. The numerical value of m will, therefore, vary according as to what is assumed as 'unit velocity." But unit velocity is the distance travelled in unit time, and hence "unit velocity" depends upon the system of units adopted for length and time.

In ordinary astronomical convention, the unit of length is the distance of the earth from the sun and the unit of time is the *mean solar day*. Using this system of units, the mass of the sun, expressed linearly, becomes:

$$m = 44{,}800 \text{ kms.}$$

With the ordinary system of units of the physical laboratory, in which the *centimeter* is the unit of length and the *second* is the unit of time, this linear value of the mass of the sun becomes:

$$m = 13.5 \times 10^{20} \text{ kms.}$$

The relativity system of units, adopted by the relativists, is adjusted so as to make the velocity of light "unity": in this system, therefore, the unit of length is the *kilometer* and the unit of time is the *1/300,000th part of a second*. And in this system of units, the linear value of the mass of the sun is expressed by:

$$m = 1.50 \text{ kms.}$$

as given by Eddington.

Now, when these various values for the "linear mass" of the sun, or for the constant m of relativity, are substituted in the formula for the motion of the apse-line, the respective motions of the perihelion of Mercury in one century become:

For astronomical units,	this motion becomes 357°, or very nearly a complete revolution.
For physical units,	this motion becomes 3×10^{16} complete revolutions: or the orbit is revolving at the rate of 9.5×10^{6} complete revolutions *per second*.
For relativity units,	this motion becomes the celebrated 43 seconds of arc.

Thus, if the m in the relativity formula for the motion of the perihelion represents the *"gravitational mass of the sun,"* as stated and claimed by the relativists, then the relativity motion of a planetary orbit depends entirely upon the system of fundamental units adopted for measuring length and time; depends absolutely upon what is called "unit velocity." Can such a motion, a motion which changes with the units employed, represent a physical fact? Is it not, rather, purely a mathematical illusion, due to an erroneous interpretation of an equation?

Charles Lane Poor

Columbia University,
May, 1924

WAXY ENDOSPERM IN NEW ENGLAND MAIZE

The peculiar type of endosperm texture in maize, familiar to geneticists as "waxy," which has previously been found only in isolated localities in China, Burma and the Philippines,[1] has recently appeared in a New England variety grown at the Connecticut Agricultural Experiment Station.

Waxy seeds were found by Dr. D. F. Jones in the fall of 1922 on two hand pollinated ears of Sanford's White Flint which were segregating in the proportion of 3 starchy: 1 waxy. Both of these ears are the progeny of a single open pollinated ear which had been received in a lot of 25 ears of this variety obtained from a farmer near Kent, Connecticut, in the spring of 1922.

The recessive seeds from one of the segregating ears were planted in 1923 and crosses were made with a waxy strain secured from Mr. G. N. Collins, of the Bureau of Plant Industry, who had obtained this type originally from Shanghai, China. When pollen from the Chinese waxy was applied to the silks of the New England waxy, only pure waxy seeds resulted, proving that the two strains are genetically identical in their type of endosperm.

As far as is known the only waxy maize ever grown in Connecticut is the Chinese strain, which has been used in genetic investigations on the experiment station farm for a number of years. No corn of any kind has ever been sent from the station to the locality from which the ears of Sanford's White Flint were obtained, and it is scarcely possible that the appearance of waxy endosperm in this variety is due to previous crossing with the Chinese waxy. Nor is there any indication that the strain in which waxy has appeared has undergone recent crossing with such a widely different sort as the Chinese strain. Sanford's White Flint is an old and well-

[1] G. N. Collins, "Waxy maize from Upper Burma," Science, N. S., Vol. LII, No. 1333, pp. 48–51, July 16, 1920.

established New England variety and the strain which carries the waxy endosperm is typical of the variety in type of plants, ears and grain.

The origin, in an American variety, of this peculiar endosperm texture, previously found only in several isolated Asiatic localities, will probably remain a matter for speculation. It may have arisen by mutation within the past few years, or it may have been carried by the stock as a hidden recessive for centuries. In any case its appearance may be regarded as a further bit of evidence against the theory of a pre-Columbian distribution of maize outside of the American continent. Nor would it be surprising if a thorough investigation, by the process of inbreeding, should bring to light waxy endosperm in a number of additional American varieties.

P. C. MANGELSDORF

CONNECTICUT AGRICULTURAL
EXPERIMENT STATION,
NEW HAVEN

THE METRIC SYSTEM

SCIENCE for June 13, 1924, contains a letter advocating the metric system. I can not see how the metric system can be of any greater value to the ordinary person than the present system. The decimalists are too fond of overrating their own exploits. Even with the coinage I find after 12 years residence in Canada that the money system is no simpler than the pounds, shillings and pence of England and I find with constant trading with the United States that the rate of exchange does away with any advantage which a common money system may have. And how is it that the "quarter" is so popular? It surely should not have a place in a decimal system. In my opinion a decimal system may be all right for an ignorant and unlettered community and possibly here the advocates in the United States may make a big claim for its use.

It is amusing to see Mr. McAdie claim that scientific men the world over champion and use the metric units. Apparently engineers and the engineering profession in general are not scientific. Why, even a cook[1] may be more scientific than a meteorologist. Mr. McAdie does not see that although it may be an advantage for those who "analyze" to use a decimal system such a system is of no importance to those who "manufacture." For the latter—and they are the useful people in this world—a binary system or a duodecimal system is much better.

I have been teaching physics in Toronto for the last twelve years and have introduced the English units more and more as the years have gone on because I find the students understand them better. Especially is this true in mechanics. I note what the writer of the letter says about the questions in the school arithmetics. I always imagined that they were inserted to give the pupils practice in arithmetical manipulation. I never thought that they would be used to condemn the English system. You might as well condemn Christianity because it is a hard faith to live up to.

The trouble with men like Mr. McAdie is that because they like a thing they think all the world must agree with them. They never see the other side.

JOHN SATTERLY

UNIVERSITY OF TORONTO

[1] Mr. McAdie is rather scornful of the cook who measures by cups.

PERMANENT PHOTOGRAPHS

DR. CLARENCE H. KENNEDY'S experience with platinum photographs as told in the issue of SCIENCE for July 11 is another confirmation of the permanence of this printing process. In the *British Journal of Photography* of December 24, 1909, was an account of some platinum prints recovered in October of that year from the wreck of a war vessel, after having been under the sea for more than five months. The cardboard mounts were disintegrated, and the surface paper, to which the prints still adhered, was ruined by the water. But the prints themselves were bright and clean as if freshly made.

Present day photographers, spoiled by the ease and convenience of modern photographic processes, may think platinum printing difficult, but it used to be regarded as very simple and easy. The paper is partially printed by daylight or electric arc, and developed in a solution of potassium oxalate and potassium phosphate. It is then passed through three acid baths, and finally washed in water for 15 minutes, the whole procedure of developing, fixing and washing taking only about half an hour. The resulting picture is, Dr. Kennedy says, as permanent as the paper on which it is printed. If the print has not been properly "cleared" in the acid baths, the paper may in time turn yellow, but the discoloration is easily removed with a bleaching solution of acidified hypochlorite without affecting the platinum image. The chief drawback to the use of platinum paper is its high price.

CHARLES MACNAMARA

SCIENTIFIC BOOKS

Galapagos: World's End. By WILLIAM BEEBE. G. P. Putnam's Sons, New York and London, 1924, xxii + 443 pp., with 24 colored illustrations by Isabel Cooper and 83 photographs, mostly by John Tee-Van. Published under the auspices of the New York Zoological Society.

SINCE the publication of "The Voyage of the

Beagle" Galapagos has been a name with which to conjure up vistas of weird reptilian life, giant tortoises, strange marine lizards, of finches and hawks unaffrightened by man and of a marine life brilliant and varied such as only the tropics can produce. Expeditions have come and gone from these volcanic wastes and have reported their biological finds with elaborate technical detail and an ever-increasing confusion of interpretations as to the species limits and relationships of the isolated faunas of the various islands of the archipelago. Save for the herpetologist, ornithologist, coleopterologist or other specialist or for the student of the many problems of evolution, geographical distribution, isolation and animal behavior, these analytical reports make dry reading, not so Mr. Beebe's "World's End."

This entertaining work is the outcome of an expedition on the private yacht "Noma" to several islands only of this large archipelago in 1923. In all less than one hundred hours were spent in exploration, mostly on five of the smaller islands of the group, Eden, Guy Fawkes, Daphne, Seymour and Tower. Excellent use was made of the time, however, and the story of adventure amidst the turbulent breakers, lava cliffs and slopes, cactus and thorn and shelly beaches loses nothing of interest at the hands of this facile, brilliant and sympathetic interpreter of nature and life.

The author is keenly alert to the biological problems involved in the adaptations exhibited by the species of animals inhabiting these waste and desolate desert islets and islands. The margin of existence is narrow, and liable to temporary and local interruptions by slight disturbances in the balance of nature. Man and the animals introduced by him have been the great disturbers. The giant tortoises are even now partially exterminated and will not long survive unless protected. On the other hand, the absence of marauding mammals in the native fauna has exempted the birds from the selective action of this factor operative on their mainland relatives.

The reviewer well remembers his impressions of the finches on Chatham Island in 1905 when the U. S. S. *Albatross,* then en route on the Agassiz Expedition to the Eastern Tropical Pacific, lay at anchor at Wreck Bay. In the thorny scrub which covers the lower slopes of that blackened, lava-strewn island the most conspicuous objects are the numerous black finches, recalling in color though not in size our own crows and blackbirds. Every vestige of protective coloration in their plumage is eliminated. Add to this the astounding lack of fear which they exhibit and the impression is overwhelming that the presence of mammals in the animal associations of any region is a potent factor in both the structure and behavior of the birds. Wild dogs ranged in the Chatham Island scrub, but they are so recent as apparently to have wrought no changes even in the behavior of the finches. One could call them up in great numbers. They would perch close at hand, even on his hat and shoulders, with freedom and seeming curiosity but without fear. Dr. Beebe notes the results of this cessation of selection in the abundance of other erratic features, such as the frequent irruptions of partial albinism and unusual behavior in breeding. Structurally one finds an orthogenetic development of bill in these finches of the Galapagos. The bill is already abnormally large in finches generally, but it is excessively large in certain species and is progressively developed among those of the Galapagos to extremes which far exceed the bounds of necessity and apparently of utility.

The book is rather sparingly illustrated but with fine taste and skill. The text likewise has esthetic qualities of rare value. The reader shares the zest of exploration, is spellbound by the tragedies of the tropic seas, with their teeming fish and bird life, and of the castaways of long ago from distant shores stranded on these desert islands.

CHARLES A. KOFOID
UNIVERSITY OF CALIFORNIA

SPECIAL ARTICLES

THE INDUCTION OF GROWTH PROMOTING AND CALCIFYING PROPERTIES IN A RATION BY EXPOSURE TO LIGHT

IN verifying the work of Goldblatt and Soames who observed that livers taken from rats irradiated with light possessed growth promoting properties—which were not possessed by livers taken from non-irradiated rats—it was found that a growth promoting property could be conferred upon muscle tissue by illuminating it after its removal from the body. It was also found in another series of experiments that irradiated rats put in the same cage with non-irradiated rats were able to induce growth in the latter.

Proceeding on the assumption that failure of growth on our basal synthetic rations without the effect of illumination was due to a condition fundamentally the same as rickets, experiments were initiated in which our basal synthetic ration of purified food materials was illuminated and then fed to rats. Here also illumination of the ration caused it to become growth promoting and, in addition, it was found that the ash content of the bones of rats receiving such a ration was increased percentagely over that of rats receiving the non-radiated ration. Later it was also

found that irradiation of fats, otherwise inactive in preventing rickets, caused them to become active and that rations which ordinarily produced wide rachitic metaphysis in the shaft bones of rats became antirachitic and promptly effected a rapid and complete healing of the lesion.

These facts have now been correlated with what is known of the properties of the antirachitic vitamine and found in substantial agreement. As a result of this experimental work, the action of direct irradiation and the reported antirachitic action of irradiated air has also become understandable to us from a different point of view.

These experiments, which have been in progress since November, 1923, will be reported shortly in the *Journal of Biological Chemistry*. In the meantime, to protect the interest of the public in the possible commercial use of these findings, applications for Letters Patent, both as to processes and products, have been filed with the U. S. Patent Office and will be handled through the University of Wisconsin.

H. STEENBOCK
LABORATORY OF AGRICULTURAL CHEMISTRY,
UNIVERSITY OF WISCONSIN

ON THE EFFECTS OF VARIATION IN FREQUENCY OF STIMULATION ON STRIATED, CARDIAC AND SMOOTH MUSCLE[1]

DURING the course of an investigation carried out by one of us on the effects of variation in frequency and intensity of stimulation of the vagus nerve on the lower end of the esophagus, the cardia and the fundus et corpus ventriculi of the cat, concerning which a preliminary note has been published,[2] it became desirable to extend experiments of this kind to direct stimulation of the different types of muscle. Accordingly, we have chosen for investigation the m. gastrocnemius of the frog, the m. omohyoideus of the turtle, the apex of the turtle's ventricle, portions of the alimentary canal of the cat and the siphon muscle of the clam. The results, which have corroborated those obtained in the vagus experiments, are here reported in a second preliminary communication.

Considering first striated muscle, frequencies of interruption of the primary current of about 40 per second cause pronounced and well-maintained tetanus of the frog's gastrocnemius and the omohyoid of the turtle, but an increase in frequency to 100 per second or more causes more or less complete relaxation. If the higher frequencies are employed at the outset, the muscle responds with a rather brief initial tetanus, relaxation taking place thereafter. The effects are most clearly obtained from the omohyoid of the turtle, for it has much less tendency to enter into a state of contracture than the gastrocnemius. These results are obtained from the curarized as well as the noncurarized muscle.

In case the stimulation is long continued, the gastrocnemius begins to contract rhythmically. This occurs best with a frequency of about 40 per second. The contractions are slowed in frequency and increased in strength as the stimulation is maintained. An increase in frequency to 120 per second or more stops the rhythm and causes the muscle to relax to its contracture level. On decreasing the frequency to its excitatory value, the rhythmicity is resumed, often after a considerable latent period. These results, likewise, are given by the curarized and the noncurarized muscle.

Injection of atropine sulphate into the dorsal lymph sac greatly increases the tendency of the gastrocnemius to contract rhythmically in response to the tetanizing current, and accordingly a much higher frequency is required to stop the rhythm in the atropinized preparation. In one experiment, in which the muscle was both curarized and atropinized, a frequency of 560 per second was hardly sufficient to suppress it. The gastrocnemius of the other leg, which had been atropinized only, exhibited a strong and quite regular rhythm in response to a frequency of 640 per second. Atropine has shown repeatedly this ability to counteract the inhibitory effects of high frequency stimulation.

The results from the apex of the turtle's ventricle have been even more striking. A frequency of interruption of 2.5 per second usually establishes a regular rhythm of contraction. A moderate increase in frequency slows the rhythm and increases the magnitude of the contractions. With a further increase in frequency, the contractions cease and the muscle relaxes almost completely. In this relaxed state, the contractile forces of the muscle are recovered, as indicated by the character of the response obtained when the frequency is lowered again to its excitatory value. Surprisingly low frequencies are inhibitory. Ten interruptions or fewer per second are often sufficient to suppress the rhythm entirely. Atropinization, however, changes the results in a significant manner. Rhythmic contractions are set up by stimulation as before, but extraordinarily high frequencies are required to suppress them—760 interruptions per second often leave the rhythm in progress. It is of interest to note also that atropinization often leads to spontaneous rhythmicity of the apex of the ventricle, which is difficult to check by high frequency stimulation. Pilocarpine, as would be expected, counteracts the effects of atropine. By its application the relations of frequency to effect produced can be made

[1] From the Laboratory of Physiology in the Harvard Medical School.

[2] Veach, H. O., SCIENCE, 1924, LIX, 260.

to revert to those holding for the non-atropinized preparation.

The results obtained from smooth muscle are likewise significant. The siphon muscle of the clam reacts to variation in frequency of stimulation in much the same way as the omohyoid of the turtle, though it relaxes in response to lower frequencies. The frequencies required to cause relaxation of the smooth muscle of the alimentary canal, on the other hand, are extraordinarily high. In one Magnus preparation[3] of the circular coat of the duodenum, taken from a cat anesthetized with urethane, frequencies of 320 and above were required to cause relaxation during stimulation. In a preparation taken from the lower end of the esophagus of a decerebrate cat, and arranged to record the contractions of the longitudinal coat, the myenteric plexus remaining intact, a frequency of 240 per second caused well-maintained, rhythmic contraction. Relaxation took place, however, when the frequency was increased to 400 per second. The latter frequency when applied to the resting preparation, the intensity remaining constant, caused contraction.

These observations tend to establish a definite relation between frequency of stimulation and the response produced in the effector: low frequencies of stimulation are excitatory and high frequencies are inhibitory. The analogy to Wedensky inhibition[4] is close, and we are inclined to account for the results chiefly on the basis of the reduction in magnitude of a propagated disturbance, which travels in the relative refractory phase following its predecessor. This has been shown by Lucas to be true for the sciatic nerve[5] and the sartorius muscle[6] of the frog. We place the seat of reduction of the propagated disturbances to subnormal magnitude in a conducting mechanism of the muscle. The reduced disturbance might be rendered thus subthreshold for the contracting mechanism. Rhythmicity is seen to be explicable on the same basis. Fatigue would lower the threshold of the contracting mechanism and result in relaxation. During relaxation, the contractile forces would be recovered, with a resulting fall in threshold, and the conditions would be established for contraction. The occurrence of contraction, however, would fatigue again the contracting mechanism, and the process might thus be repeated rhythmically. Incidentally, the results indicate that the seat of inhibition for the turtle's heart is within its musculature. They indicate also that the chief cause of the production of Wedensky inhibition may lie in the properties of a conducting mechanism of the muscle fiber.

[3] Magnus, R., *Arch. f. d. ges. Physiol.*, 1904, CII., 349.

[4] Wedensky, N., *Archives d. Physiol.*, 1891, XXIII., 687.

[5] Lucas, K., *Journ. Physiol.*, 1911, XLIII., 46.

[6] Lucas, K., *Journ. Physiol.*, 1909, XXXIX., 331.

A full account of this investigation will appear in the *American Journal of Physiology*.

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A HIGH RESISTANCE FOR USE WITH ELECTROMETERS

A QUADRANT electrometer may be used to measure current by two methods: (1) By measuring the rate of deflection when one pair of quadrants is attached to a system of known capacity which is being charged by the current to be measured; (2) by using the electrometer to measure the potential drop across a high resistance through which the current is flowing. The resistance to be used in the latter method should be high, non-polarizable and it is desirable to have it made of such materials that the magnitude of the resistance may be varied to meet the requirements of the experiment. It was suggested by Professor G. N. Lewis that solutions of iodine in non-conducting solvents such as benzene might meet these conditions.

The benzene used in these experiments was washed successively with concentrated sulfuric acid, sodium carbonate solution and distilled water, dried with phosphorous pentoxide and distilled. The iodine used was purified by resubliming the commercial product. The conductivities of the solutions were measured in a glass cell with platinum electrodes which were four centimeters in area and approximately one millimeter apart. The concentrations of the solutions tested varied from 10.62 to 2.69 grams of iodine in 100 cc of solution and the specific resistances ranged from 1.1×10^{11} to 4.8×10^{11} ohms. At the lower concentrations of iodine the conductivity is very nearly proportional to the concentration of the iodine but at higher concentrations the ratio of conductivity to concentration increases slightly. The temperature coefficient is fairly high, the conductivity increasing approximately one per cent. of the value at 20° C. for each degree rise in temperature.

Several resistances have been made using these solutions and have been tested with a Compton electrometer with satisfactory results. The currents which have been measured with this arrangement are of the order of 10^{-15} ampere, but it is evident that by suitable variation of the resistances or of the sensitivity of the electrometer a wide range of currents may be covered. If the resistance is adjusted so that with the maximum deflection observed the potential drop across the resistance is not more than about one tenth of a volt the system rapidly adjusts itself to a change of current. If actual values of the current are desired the system should be calibrated by one of the usual methods.

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CONTENTS

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THE RÔLE OF RESEARCH IN MEDICINE[1]

IN the old-fashioned, proprietary type of medical school which flourished in this country during the nineteenth century scientific research was neglected. Even where nominally associated with a university, the medical school was usually dominated by a rather narrow professional purpose, in which investigation was largely ignored. Though incidental research might be tolerated as a harmless diversion, it was more often discouraged as a mere waste of time and of no practical value. Contributions to the medical literature were usually superficial in character. As a rule, the highest ambition of the professor was to publish a text-book, which might establish or extend his fame, even though it represented no advancement of the subject through original research.

The revolution in medical education at the close of the past century brought many radical changes. The proprietary type of organization has been abandoned. We now recognize that the medical school must necessarily be an integral part of a strong university. In the reorganization of medical schools, the university ideal has become dominant. This ideal involves the search for the unknown, as well as the dissemination of the known. The modern medical schools have accepted this responsibility, and have made systematic efforts to provide for research as well as for teaching. They have recognized their duty to advance the science of medicine, in addition to the training of practitioners. Vast expenditures of money have been made to provide the personnel and facilities necessary for this purpose.

But revolutions tend to be followed by counter-revolutions. Especially in this restless, post-war period of discontentment, when all our social institutions are being challenged, it is not surprising that our medical schools are again subjected to criticism. Their efficiency has been questioned and their methods closely scrutinized. Among other things, doubts have been expressed concerning their present policies in the promotion of research. A reconsideration of the whole question of medical research and its relation to medical education therefore appears desirable.

Scientific research in general may be considered in two different aspects. Its first purpose is the increase of knowledge. With all our boasted progress, how little as yet we really know of the physical universe. Recent developments have shattered our former ideas

[1] An address at the commencement exercises of the Medical Department, University of Georgia, Augusta, June 2, 1924.

about even the structure of matter, the fundamental theories we had vainly supposed to be firmly established. And if our knowledge of the relatively simple phenomena of physics is still so inadequate, how much greater is our ignorance of the vastly more complex living organisms with which biology and medicine have to deal! Yet even the little we know forms our only basis for progress. Though still groping in darkness we have occasional glimpses of a promising future. The only hope for improvement is through continued investigation, which therefore demands our earnest attention and our continued support. The need is beyond question.

The scientific method is generally recognized as the road leading toward the desired goal. Yet there is apparently a prevalent misconception concerning the manner in which knowledge actually grows. This misunderstanding hampers the progress of all science, including medicine. To make adequate provision for continued progress, it is highly important to understand the actual mode of the growth of knowledge, which is really a process of evolution.

We may perhaps profitably compare the general process of the growth of knowledge to the development of America. First came Columbus and the other discoverers and explorers, who led the way and revealed the main features of the country and its various regions. Next were the colonizers, who established settlements at numerous convenient or strategic points. From these sources, the pioneer settlers slowly spread in various directions. The subsequent actual occupation of the country and the development of its resources were accomplished through the enterprise and energy of thousands of leaders in agriculture, industry, commerce and associated activities. But the efforts of all these numerous leaders would have been quite fruitless without the assistance and support of the millions of individual workers. Each of these played his part in making the latent resources actually available for us all. Even to this day every citizen participates to some extent in the making of America, a continuous, never-ending process. Thus leaders and followers alike are indispensable for social progress.

A somewhat similar process occurs in the extension of the bounds of knowledge. A popular but erroneous idea is that advancement is accomplished solely by the inspiration of a few great geniuses. These are, of course, essential and invaluable, but their discoveries are never entirely independent. They always represent the culmination of a series of steps or stages, including the thoughts and efforts of numerous previous workers in the same or related fields. In a very real sense, "there is nothing new under the sun." So interrelated and interwoven are the infinite parts of our common body of knowledge that they seem to form a vastly complicated mechanism, like a living, growing organism. The new develops from the old. From the very nature of things, an entirely new discovery would be quite incomprehensible to our minds. It could not be assimilated, and is therefore a practical impossibility. Every apparently new idea has its roots reaching far back into the past, and also its branches extending into the future.

By extension into the future, I mean that no discovery is completely established on first appearance. By sad experience, we have learned that caution is necessary in accepting even the most plausible new theory. Before its merit as truth is finally determined, it must be repeatedly tested and tried in its various relations. Its range and its limitations must be determined. It must run the gauntlet of skepticism by its opponents on the one hand, and of unwarranted enthusiasm and credulity by its advocates on the other. Through the inevitable test of experience, every new idea or discovery, whether great or small, thus gradually passes from the realm of uncertainty, and as confirmed approaches (but never quite reaches) the goal of absolute certainty. This applies to abstract truths or general principles and likewise to their applications, to both discoveries and inventions. The evolution of human knowledge is thus a process in which we all participate, consciously or unconsciously. In admiring the achievements of genius, we should not forget the important aid of the many plodders of lesser talent.

Nowhere is this more true than in the field of medicine. No discovery in the basic medical sciences, no advancement in the art of healing is to be credited to any single individual. Even the greatest heroes of medicine, those most richly endowed with the precious gift of creative imagination, are indebted to their predecessors for instruction and inspiration, to their contemporaries for criticism, and to their successors for the final adaptation and evaluation of their most original products. The pages of the history of medicine are crowded with examples with which you are all familiar.

The important discovery of the hormone secretin by the English physiologists, Bayliss and Starling, may serve as an instance. In referring to this work, Starling recently said:

> It was of no practical use to any one, but a source of much gratification to ourselves, since it seemed to open up a new chapter in our knowledge of the body. But there were at that time half a dozen workers skating along the edge of the discovery, and it is difficult to comprehend why, for example, Wertheimer and Lepage did not take the one further step which would have made them and not us the discoverers of secretin. . . . Every discovery, however important and apparently epoch-making, is but the natural and inevitable outcome of a

vast mass of work, involving many failures, by a host of different observers, so that if it is not made by Brown this year it will fall into the lap of Jones, or of Jones and Robinson simultaneously, next year or the year after.

Similarly, credit for the recent discovery of insulin belongs to no one man, nor even to any small group of men. Banting and Macleod, to whom the Nobel prize in medicine was awarded, very generously and properly shared it with their colleagues, Best and Collip. While these Toronto investigators fully deserve the greatest praise for their achievement, it is nevertheless well known that many others had previously worked on this problem, clearing up various preliminary stages and even coming very close to the final solution. It is unnecessary to rehearse the interesting story, which involves the unconscious cooperation of hundreds of workers, even to go back no farther than the discovery of the pancreatic islets by Langerhans in 1869. The subsequent elucidation of the nature and function of these islets required the patient labor of a long series of morphologists, physiologists, pathologists, biochemists and clinicians. According to tradition, one important step (the experimental production of diabetes by extirpation of the pancreas) was due partly to a German laboratory *Diener,* who happened to observe a sweet taste in some crystals formed by the evaporation of urine from the test animals. Accident thus plays a part in scientific research, though, as Pasteur remarked, "chance favors the prepared mind."

But even with the discovery of insulin, the subject was by no means exhausted. Literally thousands of workers, both laboratory scientists and clinicians, are now actively engaged in a further study of insulin, its chemical structure, physiological significance, standardization for clinical use, methods and limitations in various stages and complications of diabetes and in numerous other related problems. The utilization of insulin in country practice, in contrast with its use where laboratory and hospital facilities are available, raises a series of questions which can be answered only by the test of experience. It is believed that further research upon insulin will shed light on other obscurities of metabolism, with results which eventually may prove even more important than the conquest of diabetes mellitus. At any rate, this problem has enlisted the efforts of a multitude of workers interested in the various phases of what is really a huge, loosely cooperative investigation to perfect and extend our knowledge of insulin.

The recent advances in the field of nutrition, as related to the deficiency diseases, likewise represent the results of a large number of workers in various countries. The history of the discovery and application of the diphtheria antitoxin (on which work still continues), and the problems of scarlet fever and of goiter are other examples from the many which could easily be cited.

I would like to emphasize the fact that even the ordinary practitioner in the smallest village, far from hospital, laboratory or library, can, if he will, make *some* contribution to medical progress. It is unnecessary to remind this audience of Crawford W. Long, the rural doctor who first used ether anesthesia in a surgical operation. Another Georgia physician, Robert Battey, was the first to remove the ovaries for the relief of intolerable dysmenorrhea. I commend to you, members of the graduating class, these examples of your distinguished fellow-citizens as demonstrating what may be accomplished, even under very unfavorable conditions. While you may not be so fortunate as to make great discoveries, it is your privilege and duty to do what you can in the promotion of medical research. Each one of you should strive to repay at least slight interest on your great indebtedness for the common social heritage of our present medical science. If you will cultivate the scientific spirit, if you will make your observations accurately and record them carefully, if you will later study critically your own data (or make them available for the use of other workers), and if you will honestly test your conclusions, you can not fail to promote in some degree the advancement of medicine.

There are, indeed, certain important phases of medicine for the study of which the opportunities are in some respects most favorable in small communities. For example, various hereditary aspects of disease can be studied most readily in rural districts, where the population undergoes relatively little migration. Here likewise the effects of racial intermixture upon predisposition and immunity can be most easily followed. Or, as a more practical problem, it would be interesting and instructive to compare the complications met in a large series of obstetrical cases in country practice with those found in the city or under hospital conditions. Every physician of an inquiring mind, wherever he may be located, can readily find all about him numerous medical problems of importance, which he can help to solve. Whether his ability and opportunity be great or small, it is his duty to make the most of them. Aristotle long ago noted that: "The search for Truth is in one way hard and in another easy; for it is evident that no one can either master it fully or miss it wholly. But each adds a little to our knowledge of Nature, and from all the facts assembled there arises grandeur."

The recognition that mediocrity must share with genius in the advancement of science is a matter of practical importance. Therein lies the answer to those who urge that progress would be facilitated by concentrating the support for scientific research into grants or prizes limited to the few investigators of

the first rank. These gifted individuals should, of course, be rewarded and honored. The most ample facilities should be placed at their disposal. But let us not make the serious mistake of failing to recognize also the value of the contributions from the lesser lights. Their work is likewise indispensable, and each deserves encouragement and support in proportion to his merits. Our efforts to promote progress through scientific research should therefore be directed not merely to the training and support of a few talented investigators, but to securing the maximum result by aiding wisely the activities of all. While many agencies may cooperate in the prosecution of research, we naturally look to the schools as the most potent factor in the promotion of science.

This brings up the second aspect of the research question. While the resultant increase of knowledge would fully justify all our efforts to promote scientific research, there is another reason equally good, though often overlooked or unappreciated. It is the educational principle that all instruction is most effective when imbued with the research spirit, inculcating the scientific method.

Let us first examine this question in its relation to general education, with which medical education is inseparably connected. We may assume that the primary purpose of education is to afford training which will aid in solving the problems of life. Broadly speaking, the methods of education, past and present, may be classified under two headings: the dogmatic and the scientific. Until quite recent times, education has been almost exclusively by the dogmatic method. The underlying principle of this method is to provide a system of rules for the guidance of conduct, or, in other words, a set of ready-made solutions for the problems of life. The teacher "lays down the law"; the student accepts it passively. Learning is chiefly through memorizing from lecture or text-book. This, the method of authority, has been a favorite throughout the ages, and is still predominant.

Doubtless many of you can recall personal experience with this system, especially in the elementary schools. In arithmetic, where there was perhaps the best opportunity for independent thinking, you noted that many students, through laziness or inability, relied entirely upon their classmates to solve the set problems. The more able and industrious faithfully worked out these problems, following the rules and "examples" as given in the text-book, but with little or no comprehension. Occasionally an ingenious pupil might actually dare to propose an original solution, to the astonishment of the class and (often) to the perplexity of the teacher. In the other branches of study, the methods were similar. Memorization was everywhere at a premium, and originality discouraged.

While conditions have undoubtedly improved, there is ample evidence that the cultivation of independent thinking in our schools and colleges, though recognized in theory, is still too rare in practice. The dogmatic method stubbornly persists, in spite of the efforts of numerous educational reformers, who, from time to time, have tried to introduce the scientific method as the basic principle of pedagogy. The pioneer in this attempt was Comenius, who nearly three centuries ago urged that:

> Men must, as far as possible, be taught to become wise by studying the heavens, the earth, oaks and beeches, but not by studying books; that is to say, they must learn to know and investigate the things themselves, and not the observations that other men have made about the things. We shall thus tread in the footsteps of the wise men of old, if each one of us obtain his knowledge from the originals, from the things themselves, and from no other source.

Rousseau likewise insisted that our first teachers are our hands and eyes. "To substitute books for them does not teach us to reason, it teaches us to use the reason of others rather than our own; it teaches us to believe much and know little." Rousseau expressed what is now termed the heuristic method as follows: "Let him know nothing because you have told him, but because he has learnt it for himself. Let him not be taught science, let him discover it." The same plea has been echoed in vain by subsequent reformers, down to the present day. Even in the teaching of the sciences, the dogmatic method, rather than the scientific or heuristic, has generally prevailed.

This heuristic plan of teaching seems to be in especial accordance with the nature of childhood, where curiosity is so prominent. Every normal child is a living question mark and an eager investigator. Soon, however, this native curiosity seems largely to disappear. Is it merely outgrown, along with other primitive characteristics of the childish mind? Is it stifled by our artificial mode of education? Or does it still persist, though diverted into other less obvious channels? The answer to these questions is important for our present theme, because the research spirit depends to a large degree upon the persistence of curiosity as a mental trait. While society encourages scientific progress for utilitarian purposes, the strongest motive for research in the individual is the desire to know. An unquenchable thirst for the truth is the chief stimulus of scientific investigation.

While this primitive spirit of inquiry persists in every one to some extent, in most individuals it apparently weakens. Conservatism notably increases with age. Human nature prefers to follow the lines of least resistance, and drops readily into the well-worn channels of custom. Innovations are disturb-

ing and are therefore subconsciously resented. This perhaps may help to explain why authority and book-worship remain so strongly intrenched, and why the scientific attitude makes slow headway in our schools.

Another drawback is the greater difficulty and expense of teaching by the scientific method. It requires more able teachers and more extensive equipment. As a result only feeble and sporadic attempts have yet been made to train students in the systematic application of this method to the problems of life. It is true that the pedagogic doctrine of formal discipline has been abandoned, and it is realized that no specific form of training gives ability to cope with other problems quite different in character. Nevertheless, in school work mental and physical habits are formed, and these do carry over and affect behavior in new and different situations. This possibility gives science unique significance in education, and justifies great hopes for the future.

The obvious defects in our present system of general education naturally limit the possibilities of later medical instruction. Medical students begin their work handicapped by inadequate earlier training. They have already passed the youthful age of greatest mental plasticity, when desirable habits and attitudes are most easily established. Medical teachers often complain that the incoming students memorize readily but are notoriously deficient in powers of independent observation and reasoning. Especially in the earlier years of the medical course, it is necessary to devote much time and energy to training in scientific method, if this is to be made the basis of medical education. Great emphasis is therefore laid upon scientific research, even during undergraduate work, because it is assumed that the same principles and methods are required for efficiency later in the practice of medicine.

But is this a valid assumption? Some writers have lately challenged this principle, asserting that while scientific research is desirable for the advancement of knowledge, it bears no relation whatever to efficiency in practice. Thus a recent critic (in "Our Medicine Men, by One of Them") states that "there is no such thing as a science of medicine and that the study of disease is a matter distinctly apart from the art of healing"; that clinical practice "is entirely antithetical to the spirit of science"; and that in medical education "what is necessary is a sharp delineation between the practical sheep and the scientific goats. This should take place at the very beginning of the medical course."

An editorial in a recent number of *Surgery, Gynecology and Obstetrics,* criticizing undergraduate medical teaching, likewise asserts that, "If perchance we should occasionally turn out a scientist or an embryo discoverer, so much the better, but it is a fatal mistake to try to make all our students research workers in the hope that one or two of each class may ultimately turn out to be a real scientist."

A prominent physician, in a recent article on medical education, similarly maintains that:

> There is no place in the actual practice of medicine for sustained medical research. It is condemned by law, and, according to all moral standards, is a reprehensible practice. No man employs a physician to advance science at his expense and risk. No man would knowingly tolerate it. If a student is taught to do research work on his patients in the university hospital and is complimented on something great or small in connection with it, he might become convinced that that was a proper or permissible course—convinced, in a word, that the patient is only a sort of advanced laboratory animal. Could he then reasonably be expected to disgorge his mind of all these impressions and become an honest servant of his patrons on graduation? Would he not feel justified in trying out his new ideas on them?

The obvious reply is that all depends on the definition of research. That every case presents a new scientific problem has often been pointed out and is generally admitted. Every patient is not only willing but anxious to be the subject of scientific research, it he understands that to mean the most careful attempt to discover the exact nature of his affliction, and to find the most appropriate and efficient remedy. The scientific spirit is entirely consistent with the highest humanitarian motives, which make the welfare of the patient the foremost consideration.

It would indeed be hard to find a better example of scientific methods than the ordinary procedure in medical practice. The diagnosis represents the first step in the analysis of the problem. For the discovery of the existing facts, the case history is taken. This is followed by a systematic and careful examination to reveal the present state of the patient, the observer using both the unaided senses and the various instruments of precision. In seeking the cause of the disorder, provisional hypotheses must be verified or corrected by comparison with the observed data, and by further tests for purposes of differential diagnosis. The prognosis really represents a scientific prediction, the validity of which is tested by the outcome. The choice of treatment is a deduction from the diagnosis, under all the ascertainable conditions affecting the individual case. The results of treatment further confirm or disprove the previous line of reasoning. Rational principles likewise determine the method by which the recurrence of the disease is most likely to be prevented. Thus medicine exemplifies the typical scientific methods of observation, hypothesis, deduction and experimental verification.

As Barker puts it:

The study of a single patient by modern methods includes the making of a very large number of experiments, that is, of test procedures adopted on the chance of their yielding to observation under especially controlled conditions definite information that is not obtainable by simple non-experimental observation. There is no other science in which the technic of accumulating facts is as extensive as in clinical medicine, for its methods of examination are based on and include the technical methods of all the preliminary natural sciences and of all the intermediate, simpler preclinical sciences.

In contrast with this concept of medicine as a science, we have what may be styled the empirical method, which disdains science as impractical, and attempts to deal directly with the phenomena on the basis of experience. The empiric generally treats merely the symptoms, or the symptom-groups (syndromes), which are designated as the various diseases. He scorns the scientific concept as theoretical and visionary. Yet often he is unconsciously himself a slave to the most absurd theories, which lead him far astray. Empiricism sometimes achieves brilliant success, but more frequently results in failure. As Minot once remarked, the difference between the so-called practical doctor and the truly scientific is that the patients of the former are more likely to die. The scientific practitioner looks beyond the symptoms and persistently seeks to remove the real cause of the disorder, by more difficult but more rational methods. He knows and frankly admits his own limitations, which is the beginning of scientific wisdom. Success in practice demands scientific judgment and practical skill, both of which are dependent upon the character of the previous training, though perfected by further experience.

We should, therefore, protest against the custom of designating the fundamental branches of medicine as "scientific," in contrast with the "clinical" subjects, which by implication are thereby considered unscientific. The methods used are, or should be, essentially similar in all parts of the field of medicine. The primary aim of the practitioner is to interpret and control the clinical phenomena. The purpose of medical education is to give the training which makes this possible, through a working knowledge of the human organism under both normal and abnormal conditions. Mastery of the basic data and their utilization at the bedside alike require the persistent application of the same scientific methods by which all knowledge is discovered. While medical instruction can not possibly foresee all the specific problems which will arise in practice, it can and should provide the methods of procedure by which the future practitioner will be able to meet and solve these problems in the most effective manner. The more thoroughly medical practice becomes imbued with the spirit of scientific research, the more successful will it be.

The scientific method should, therefore, be made the guiding principle throughout the medical curriculum. In all medical instruction, it should be kept constantly in mind. Every teacher should be an active investigator. Moreover, I firmly believe that every medical student, at some time during his course, should have the opportunity to undertake on his own account a modest bit of original research in the more formal sense. Although the resultant contribution to the common stock of knowledge in most cases would be slight, the experience would be invaluable in giving him a better grasp of the scientific method, its uses and its limitations. The limited elective system in the medical curriculum, now growing in favor, gives this needed opportunity. If adopted in all first-class medical schools, this system would provide, or at least make possible, a good substitute for the medical thesis, an ancient requirement still maintained in the best medical schools abroad. This encouragement of productive scholarship helps to emphasize the scientific character of medicine.

The application of scientific research to the problems of medicine will doubtless result in the improvement of medical practice, not only along the conventional lines, but also in opening up new modes of treatment. For example, the study of psychology in its relation to medicine presents, in my opinion, one of the most promising and fruitful fields of the future. I refer not merely to psychiatry, but to the psychic aspects of medicine in general. Psychotherapy has been sadly neglected by the medical profession, though largely utilized in empirical fashion by various cults and quack systems. Medical science should be open-minded and devoid of prejudice, ever ready to recognize the truth, whatever its source. Great possibilities are in store for the future, perhaps in directions entirely unexpected.

In our efforts to promote medical progress we must be not only tolerant but patient. We must not expect results too quickly. In medicine, as in other fields, we should realize that "Science moves, but slowly, slowly, creeping on from point to point." The achievements of the past, however, encourage us to look hopefully to the future. We are on the right path and moving in the right direction. And with the more general recognition and support of the scientific method in medical education and practice, we may confidently expect that improvement will become increasingly rapid and certain.

In conclusion, let me repeat that in medicine as elsewhere the rôle of scientific research is twofold. In the first place, it presents the indispensable means for the continued growth of our common body of knowledge, a process in which plodding talent must cooperate with creative genius. In the second place, it provides also the methods by which this knowledge can be most efficiently applied in solving the daily

problems of life. We must, therefore, recognize the fundamental importance of the research spirit, for education in general as well as for medical training and practice.

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RECENT ACHIEVEMENTS IN PALEOBOTANY

Until within the last few years a sort of forbidding lonesomeness has seemed to attend the student of fossil plants. Paleobotany is in fact the last of the paleobiologic trio to reach accuracy and finality in the methods of research employed. Above and beyond the discovery of new materials, the great need is men. There are far too few workers in definitely recognized paleobotanic positions which make active contribution possible—in all the world a few over twenty. In Germany there is Gothan, Kräusel and R. Potonié; in Sweden, Halle; in France, Carpentier and Paul Bertrand; in Austria, Kubart; in Holland, Jongmans; in Great Britain, Kidston, Lang, Scott, Seward, Benson, Weiss, Stopes, Oliver; in India, Sahni; in the western world, Knowlton, Berry, Noé, White, Jeffrey, Wieland, Goldring, Torrey, Chaney.

Where the workers are so few, contributions uniformly fail of needed criticism, and such comment as does rise to the surface may not have a sufficiently constructive effect. Only in subjects where elaborators are active and their fields somewhat overlap, does criticism become an organic, functioning thing—a force such as can carry the study of ancient plant life to the goal. There is pith in the remark of Dr. Marie Stopes that "paleobotany requires a serene civilization."

Turning to actual discoveries the initial dates may serve. Taking the past thirty-five years, that is, the close of the last century and the opening of the present, the outstanding discoveries and elaborations in the larger fields are: Seed cone of Bennettites Morierei, Lignier, 1894; finding of new localities of American cycads, Macbride, Ward, '93–94; volumes on the status of the Mesozoic floras with initial description of cycadeoids by Ward, '99–'05; cycadeoid collection and discovery of fructification and foliage, Wieland, 1898–99; early Williamsonians, Nathorst, 1902; great development of "coal ball" study by the British group of paleobotanists leading to the publication of great text-books on fossil plants and especially to the determination of the seed ferns by Oliver and Scott, 1903; taxonomy and distribution of American Carboniferous floras by White with codiscovery of seed ferns; the microspore-bearing disk Codonotheca, Sellards, 1903; chemical methods and demonstration of Williamsonians by Nathorst, 1907; sustained investigations of American dicotyledonous floras by Knowlton and Berry; brilliant study of the Kreischerville lignites by new methods, Hollick and Jeffrey, 1909; many Mexican Williamsonians with the latest of the typical Cordaite floras, Wieland, 1916; Rhynia of the lower Old Red of Scotland, the most primitive of vascular plants, Kidston and Lang, 1917; extension of the Hollick and Jeffrey methods to wider studies of lignitic gymnosperms of Cretaceous time, Torrey, 1923; collection and initiation of microscopic study of an immense series of American "coal balls," Noé, 1923; the Gilboa forest plants of the Upper Devonian of New York, Goldring, 1924.

While it is unlikely that any of these events, discoveries and accomplishments will seem to diminish in importance as the years pass by, others not mentioned may be found significant. Other names stand out, such as Zeiller, Grand-Eury, Bertrand, Gothan, Pelourdé. Although when the present century draws to a close some reviewer will surely throw into broader and fuller light as an outstanding event of these earlier years the discovery of the Pennsylvanian "coal balls." There doubtless are calcified parts of coals of extensive occurrence in other horizons than the Carboniferous. But it already appears that if any pre-Cretaceous forests may ever be fully and thoroughly reconstituted from a cosmopolitan record they must be those of the coal swamps. It is improbable that vegetal life of other periods can ever be so extendedly visualized from precise structure. The coal itself, both bituminous and anthracite, has been recently found from polished surfaces etched by flame to have the structures of lignites and of the "coal balls." Only in the latter (petrified parts of coal seams) has nature done the staining and imbedding for the investigator, who merely requires application of the simpler but well-carried-out arts of the lapidary and thin sectioner of rocks.

Just 69 years have passed since Joseph Dalton Hooker and Edward William Binney turned their attention to the seeds of the coal balls, and it appears incredible that Americans should have let all these years pass away without noting or reporting a single coal ball or cutting a single thin section from such, if a few sections of English material cut at Yale be excepted. However, the American coal balls are all at once here from Illinois, Indiana, Kentucky, Texas; and they are the key to a record of imposing extent and importance. What limits may be set to the data these great accessions may be made to yield no one now living may say. As we stand at the threshold of this new era in the study of ancient plants, the question of questions is, What were the ancestors of the Jurassic and lower Cretaceous dicotyls? Are the

recent glimpses suggesting intense parallelism and great antiquity of forest types illusory? It seems not.

Professor Noé and one of his students announce the presence of angiospermous and in fact monocotyledonous structure in the materials already sectioned, although their view meets adverse criticism. Correctness or error here must depend on later more elaborate study and should not be too strongly affixed to any initial descriptions. Noé and Hoskins dismissed identity of the stems (or petioles) revealed by their sections with Myeloxylon the petiole of Medullosa, to which especially so great an authority as Seward pointedly objects. How far can objection be sustained? Or, if there is a mere presence of Medullosan structures, are such throughout more gymnospermous than angiospermous? *Possibly they are not.* If each type of tracheid, vessel, stem or flower or finally fossil plant, suggesting the presence of a link in angiosperm descent, is to be summarily cast out because the evidence is incomplete or contrary to old interpretations or on the ground that only a so-called pteridosperm is concerned, the riddle of angiosperm origin can never be solved. Yet no one would maintain that the early angiosperms, letting the word for convenience include the line of descent as far back as flowers may go, those for instance of Permian time, were not numerous.

The Medullosa of Cotta is widely known, and the later study, down to interesting comparisons with Heterangium and Lyginopteris, indicates early gymnospermous features—mainly cycadeous. No more than when Weber about 1880 found that Myeloxylon was the petiole of Medullosa could any one until very recently have suspected the presence of a Medullosan angiospermous relationship or antecedency. But the cycadeoids throw all ancient cycad-like structures under suspicion of relationship to the earlier angiospermous phyla. They were complex of habit, cosmopolitan in distribution and their floral plan was that of the flower of Linnaeus. Moreover, it is not the later cycadeoids but exactly the Triassic Wielandiella that first suggests angiosperm affinity; while the Medullosans as a detached group of highly variant structure may well include members near if not within the line of angiosperm descent. Going back in time, related lines must approach. And while monocots are admittedly more recent than dicots, both appear old and may have arisen at much the same time.

Many of the Medullosans are giant forms, always more or less deceptive. But the woody cylinder in the different types was of a very varied structure, greatly subject to reduction, or, as may equally be said, less giant development and specialization. The secondary wood is soon lost by the leaf traces as they leave the parent stele, and the steles themselves are subject to diminution. Consequently, with the monocot-like bundle features and distribution in the petioles most marked, and the *sheer certainty* that vessels even could develop from the large tracheids, other tracheids becoming reduced, monocot relationships are a possibility.

The Medullosans display a fundamental difference from the cycadeoids, cycads and Lyginopterid seed ferns, in the absence of leaf gaps. The Myeloxylon "petioles" are merely branches, and the breaking up of the steles is due to unknown causes. Such are the unusual features that favored a transition from Myeloxylon-like structures into actual endogenous stems. In fact, Medullosa is at least semi-endogenous. Thus *Medullosa pusilla* of the lower Coal Measures is one of the smallest of all Medullosans, stem and leaf bases being only two centimeters in diameter; while according to Scott the *hypoderma* of the leaf trace is simpler and does not appear to have had any secondary tissue of its own on leaving the stele. And finally, Kubart beautifully figures *Heterangium Sturii* as a typical but primitive type without a secondary xylem cylinder. Such a stem could merge into or be taken as the end result of the loss of the Medullosan secondary wood; for Medullosa is only a polystelic *Heterangium.* And don't forget the sheathed bundles.

The monocotyledons are extreme herbaceous types. It has even been suggested that palms are in their second childhood. There is no enclosing tubular stele. Secondary growth is replaced by peculiar development of strand sclerenchyma. The foliar supply is the great feature tied up with a dense peripheral bundle grouping. This is the antithesis of the dicotyl condition (stem) with progressive elimination of the large medulla and increasing importance of the secondary wood. Hence such a Medullosan stelar equivalent as Heterangium may have supreme importance as an evolutionary turning point, where the protostelic primary wood could easily lose its thin enclosing secondary xylem. The trigonid floral plan must also be old. Trigonocarpus, Seward considers "fairly assigned" to medullosans. (Fossil Plants III, 13.)

That the Medullosans, so to speak, reach the evolutionary parting of the ways has been in the mind of several paleobotanic writers. The Medulloseae or their immediate relatives may well stand near the point where one great race began to use secondary wood in its stem architecture, and another the sheathed bundle.

In the cycad *Encephalartos Barteri* there are in the seedling stem three concentric steles, each like a Medullosan stele, which unroll to form the xylem cylinder. And Miss DeFraine called attention to the fact that by loss of internal tracheids a Medullosan pro-

tostele like Sutcliffia could give rise to the cycadean woody cylinder. But the course of change could as easily occur in the reverse. The Medullosan protostelic strands could come to dominate, as the small amount of secondary wood in certain Heterangiums proves. For, as stated, each stele of such a type as *Medullosa Anglica* is the equivalent of the single cylinder of a Heterangium, both as to the primary and secondary wood; while the Heterangium primary wood extends to the stelar center in contrast to the medullated Lyginopteris. Yet in no case is a pith absent, and it is but a step to the Myeloxylon condition, foreshadowing, if not actually representing, early monocotyledonous structure. Again, Noé and his students have found the root structures which accord with these views of change toward the monocotyledons.

That the Medullosans include some of the precursors of later and higher types of flowering plants is a likelihood enhanced by the recent discoveries in the Devonian of the State of New York. The plants of the Gilboa forest are called *Eospermatopteris,* and are referred directly to the seed ferns. If the redintegration of *Eospermatopteris* by Dr. Goldring as based on the small cupulate seeds, microspore-disks, foliage and associated stumps is correct (and I believe it to be essentially so), an early Medullosan type comes into view. In the description of the stems it is said that some of the smaller ones show (well within the outer stereome zone) "toward the center an irregular ring of sclerenchyma tissue, and within this ring and to some extent outside it irregularly scattered strands of sclerenchyma tissue." All which befits a Medullosan, unless secondary to maceration and pressure. But the stumps show excellent preservation, taken as casts. Marked displacement or flotation of the wood or of any of the other tissues during fossilization seems little in evidence and this opinion is given from a huge symmetrical specimen brought from Gilboa by Professor Dunbar, of Yale. Apparently the Medullosan record extends all the way through the lower Carboniferous down into the Devonian, although what was already known of the group, particularly the relation to Heterangium, would have permitted the assumption of this early appearance, even as a giant form.

Going further, the symmetrically lobated microspore-bearing disk Codonotheca has not had the attention it deserves, not even from Kidston and Jongmans when their material demanded comparison. Codonotheca is probably a Neuropterid of Medullosan affinity, and it looks like some cupulate Rhabdocarpus seed attributed to Medullosa. The campanulas are extremely abundant. Split nodules from Mazon Creek no larger than one's hand sometimes bear three or four of the disks, some of which contain quantities of microspores; most singular if these merely drifted from other plants into position along the bundle ridges of the campanula. That is, the evidence, whether Rhabdocarpus and Codonotheca are ever amphisporangiate or not, suggests that some of the Medullosans bore flowers constructed on the cycadeoid and angiospermous plan.

The Medullosans lasted too long in geologic time, were too cosmopolitan, too varied of structure, to be unquestioningly classed as seed ferns or cycadophytes through all their record. If they advanced floristically as did the cycadeoids, and there is much reason to believe they did, the seed fern categories will shortly need revision. "Pteridosperms" have become over-inclusive in fossil plant classifications, more especially those of Seward and Scott. But a few more years will bring determinative discoveries. In the prosecution of science nothing is so unfortunate, nothing so to be feared, as failure to admit the import of new or previously obscure facts which require expression and discussion.

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WHITE INDIANS OF DARIEN

THE story of the Marsh-Darien Expedition, organized and led by Richard O. Marsh, of Brockport, N. Y., has been told in detail in the daily press to the last of March, when it left the first base-camp, at Yavisa, in the lower Chucunaque Valley. During the preceding seven weeks southern Darien had been quite thoroughly explored without finding any blonde Indians, although Mr. Marsh had seen several at Yavisa in the summer of 1923. It is probable that any white Indians residing in that territory had hidden themselves because of the wild reports concerning the purposes of the expedition. But Mr. Marsh remained confident that white Indians would be found in the upper Chucunaque basin or in the Cordillera of northern Darien.

By the end of March, the Chokoi tribe in the lower Chucunaque Basin and the Cunas of the upper Tuyra Basin had been studied by John L. Baer, with skull measurements, and a considerable collection was made of Indian ornaments, utensils and structures. Many thousand feet of motion-picture film was taken by Charles Charlton, the Pathé photographer. Intensive study was made by Charles M. Breder of the lower vertebrates, and large collections secured. A large number of skins of birds and mammals were obtained by J. A. Johnson, the naturalist and taxidermist of the party. Some physiographic and meteorologic data also were obtained by the writer.

The failure to find any blonde Indians in southern Darien, while disappointing to Mr. Marsh, did not shake his confidence that they existed and that they would be found in the north. On March 27 the Ya-

visa camp was broken, and the writer returned to Panama with the collections to that date and part of the camp equipment, while the party of 12 white men and 15 Panamanians and negroes, in six piraguas with heavy equipment and supplies, "burned their bridges" and pushed north into entirely unknown and reputedly hostile territory. The northern district is occupied by Indian tribes that have inspired their neighbors with fear and have wisely and justly excluded intruders and have kept their blood pure.

The physical difficulties encountered by the party on the northward hike were much greater than any obstruction offered by the Indians. The time was the beginning of the wet season, while the rivers were yet low and the channels filled with log-jams and the scanty flow liable to sudden and heavy floods. In one stretch ten days were used in going 20 miles, it being necessary to chop and dynamite paths for the piraguas. During this terrible trip the party was reduced, by expiration of leave, by sickness, death and desertion. Senor Raul Brin, the Panamanian representative, was attacked by fever, returned to Panama and died. Mr. Baer had been weakened by blood-poisoning, due to "screw-worms," and died at Caledonia Bay after heart-breaking carriage across the mountains. The negro and Panamanian helpers dropped away, Mr. Breder fell ill and went to Colon, and the only original members of the party who remained with Marsh to the time when he found the white Indians were Charlton and Johnson.

The Indian people of the Atlantic coast of Darien, generally known as the San Blas, are a superior group in an advanced stage of culture, and must not be called "savages." They are threatened by the white man's diseases, by encroachment of the negroids and by what they claim to be unjust treatment by the authorities. When Mr. Marsh had crossed the Cordillera and reached Caledonia Bay with his reduced party he found the Indians in danger from smallpox. Going down to the coast to a navy wireless station on the coast of Colombia he obtained doctors and vaccine from Colon and checked the epidemic. This, along with extended conferences with the chiefs, won the confidence and friendship of the Indians. The chiefs, in assembly, agreed to follow his advice and accept his help in safeguarding their people. Then Mr. Marsh said that he wished to see their white people. They replied that there were no white Indians. Marsh told them that he knew there were, for he had proofs and had seen several. He also said that their white Indians would interest the people of the United States and form a bond of sympathy which would aid in securing their safety and protecting their rights. Then they called in the white Indians from their seclusion in the hills, and they appeared in great numbers. The moving and still pictures taken by Charlton will be evidence. About 400 blondes were seen and information given that they have villages in the hills of the Cordillera. Such a village had been seen by an army aviator.

Mr. Marsh was told that their legends were to the effect that white members had existed in the tribes from ancient times, but that their hatred of white Europeans, on account of the Spanish cruelty, had resulted in dislike of their own white people, and that they had tried to suppress them. The effect was their seclusion and segregation in less accessible districts.

Three white children were selected by Mr. Marsh from among many that were offered to him, and with five dark adults they were brought to New York on July 6. One of the blonde children is a robust girl of 14 years, the father and mother being among the five dark adults. These parents have had seven children, five being white and two dark. The mother's mother was a white Indian. The two other children are boys, one 14 and one 10 years, the latter selected as the best example seen of the dark blotching of the white skin. These children have golden hair, hazel or hazel-blue eyes and pink gums. Mr. Marsh says that he did not see a typical albino among the hundreds of blondes. He believes, from his observations on the San Blas, that there are at least three types of Indians, possibly due to the commingling on the isthmus of migrations from the northern and southern continents. He thinks that the white girl and her parents represent a type of larger frame, larger heads and generally a more lusty physique than the ordinary San Blas. He feels sure that the blonde strain will be found limited to this type.

We find here an interesting ethnologic problem. The evening of July 8 the Pathé News gave a dinner at the Waldorf-Astoria to Mr. Marsh and his Indians and members of his expedition, to which were invited a number of anthropologists. The white children were examined at this conference, and it was the unanimous opinion that the phenomenon was not albinism. Major Cuthbert Christy, of England, a specialist in tropical diseases, thought it was pathologic, due to some physiologic condition inhibiting pigmentation.

The anthropologists of the American Museum of Natural History examined the Indians and attributed the whiteness to albinism. Their report, given currency in the daily press and in the *Literary Digest* of August 9, contains, as stated by Mr. Marsh, an unfortunate error, that the smaller size of the heads of the dark Indians is due to massaging in infancy. This statement was based on reply by the Indians to questions which they misunderstood. When subsequently questioned by Mr. Marsh they repudiated with scorn and amusement the idea of any manipulation of the heads of the children.

In connection with the recent meeting at Toronto of the British Association three members of the Sec-

tion of Anthropology visited the Indians at their camp on the St. Lawrence, in the absence of Mr. Marsh, and concluded that the white characters were a form of albinism, and that ostracism had encouraged its propagation, as summarized by the chairman, Dr. F. C. Shrubsall, in a short presentation at the close of the meeting. Following this paper, Mr. Marsh made the following statement:

(1) The difference in size and shape between the skulls of the blonde Indians and those of the standard San Blas has been attributed to artificial deformation of those of the dark infants, while those of the white infants are natural. This is wholly untrue. The San Blas Indians do not massage nor in any way alter the heads of their children. The rounder, broader and higher crania of the whites can not be explained in that way.

(2) The timid demeanor of the children and the behavior of their eyes when under inspection by strangers is misleading. They are not mentally deficient nor abnormal in any way. On the contrary, they are unusually alert and keen, with excellent memory. They are rapidly learning English.

(3) That the blonde Indians do not spring from the normal San Blas Indians but from the larger and more robust type, which occupy the hills back from the coast.

It is evident that the great number of these blonde Indians and their birth from both white and dark parents present an interesting and important problem, either ethnologic or medical. Thus far we have the following tentative explanations:

(1) A peculiar form of transmissible and stabilized albinism. This names but does not explain. The blonde complexion, the procreation and the large number rule out ordinary albinism.

(2) Some disease or pathologic condition preventing pigmentation. It appears that the physiologic defect is transmissible as an acquired character.

(3) That the blondes are biologic "sports." This argues for a new variety or race of the human species.

(4). That the phenomenon is atavism, the effect of a long-ago infusion of white or Nordic blood. The anthropologists are inclined to discredit the many legends of ancient or Pre-Columbian immigration from Europe. But it may be wise to critically review the historic narratives.

One important matter is not yet determined, that is, if the white parents ever have dark children.

Summarizing, it would seem that we may be limited to two views. The first three of the above explanations suggest the initiation of a new white race, and fortifies the belief of many anthropologists that our own white race sprang from dark ancestry. Either this explanation or the ancient introduction of Nordic blood.

All agree that Mr. Marsh deserves great credit for his persistence in the face of great difficulties in making a very important discovery. Dr. Aleš Hrdlička has said:

. . . The phenomenon deserves a thorough scientific investigation, and Mr. Marsh deserves the thanks of American and British anthropologists for having brought to their attention a subject of considerable scientific interest and importance.

It is the purpose of Mr. Marsh to make another expedition to Darien, equipped for thorough ethnologic and medical study. The Indians are very reticent about their family and tribal affairs, and it will require tactful and sympathetic handling to obtain the full truth concerning this matter.

Mr. Marsh is also intent on finding some way of establishing ownership by the Indians of the lands which they have held so long, of protecting them from the dangers that surround them, of assisting them in sanitation and agriculture and of helping them to live their own life in their own way. They are an admirable people and should not be encouraged to adopt the many vices which we call civilization.

The moving pictures taken by Mr. Charlton will soon give on the screen a vivid story of the Marsh Expedition.

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SCIENTIFIC EVENTS

THE WORLD POWER CONFERENCE[1]

THE World Power Conference held in London, June 30 to July 12 was, from many points of view, the most notable gathering of its kind ever convened. It attracted large representations of engineers from many nationalities to London, and the various sections of the program reviewed the power problems of the world with a completeness that has never before been attempted.

The conference was organized by the British Electrical and Allied Manufacturers' Association in cooperation with numerous technical, scientific and commercial organizations. The purpose was to consider the sources of world power by evaluating the resources of each country, by comparing experiences in the development of scientific agriculture, irrigation and transportation, by engineering conferences, by consultations of power consumers and power-machinery manufacturers, by financial and economic discussions, and by conferences looking to the establishment of a permanent world bureau for the collection of data and the exchange of industrial and scientific information.

The conference was formally opened on Monday

[1] From *Mechanical Engineering*.

afternoon, June 30, by the Prince of Wales in the large conference room of the British Empire Exhibition. Lord Derby, president of the conference, presided at this ceremony. In his address the Prince of Wales extended a cordial welcome to the delegates to the conference and expressed the hope that the personal contacts gained during the discussions would form the inspiring motive of progress in every great activity connected with modern industry. Sir Joseph Cook responded on behalf of the British Dominions, Dr. G. Semenza of Italy, spoke for the European countries, and O. C. Merrill, of the United States, replied for the Americas. Mr. Merrill received considerable applause when he stated that mutual understanding was badly needed in the world at the present time and that contacts between people more than contacts between governments would bring about that understanding.

More than four hundred papers were presented from over forty countries, which were classified for discussion under the following headings: Power Resources, Power Production, Power Transmission and Distribution, Power Utilization and General. Under this last heading financial, economic and legal considerations were discussed, as were also research, standardization, education, health and publicity. In the Survey of Engineering Progress in this issue will be found very brief abstracts of some of the foreign papers which deal with topics of outstanding importance. Forty papers presented by American authors summarized the results of American progress in power generation, transmission and utilization, and included a summary of American resources. The complete proceedings of the conference will be included in four volumes approximating 5,500 pages, which are to be published by Perry Lund, Humphries & Company, Ltd., 3, Amen Corner, London E. C. 4, England. The publishers will send a prospectus of contents upon application.

The technical sessions were held mornings and afternoons, sometimes three at a time, on the first ten week days of July. The meeting places were the conference halls at the British Empire Exhibition. The papers, which had been printed in advance, were presented by title and thrown open to discussion by the delegates present. Over one hundred and seventy-five Americans were at the conference and many of them participated actively in the technical sessions. Among the presiding officers were George Otis Smith, director of the U. S. Geological Survey; David S. Jacobus, John W. Lieb, John R. Freeman, Fred R. Low, Joseph W. Roe and R. A. Millikan. Arthur Surveyer, president of the Engineering Institute of Canada, presided at one of the sessions on Water Power Resources. Among those who discussed the various papers were W. L. R. Emmet, David Rushmore, W. S. Murray, Sanford Riley, O. F. Junggren, Geo. A. Orrok and Lieutenant R. B. Alexander.

At the concluding sessions, which were held on Friday, July 11, there was a review of the activities of the previous day's sessions and plans for future development were considered. At this session Mr. Merrill pointed out that the papers and discussions would be a source of reference to engineers and other for many years to come. Each country had brought its own contribution and the questions had been discussed in a spirit of confidence and cooperation. There had been general recognition of the fact that scientific knowledge was common property and should be used for the common purposes of mankind. Resolutions were passed asking that each country which participated in the conference create and maintain a permanent national power committee from which delegates would be appointed on an international executive committee which would for the time being carry out the necessary work arising from the conference. Another resolution recommended that the organization which had convened the London conference should remain as an organization during the transitional period. The following general resolution was unanimously carried: "That this conference is of the opinion that the world's most crying need to-day is greater production and manufacturing activity among its peoples under conditions which will promote individual prosperity and happiness, and that this can be largely achieved by the fuller development of national power resources and by the establishment of the most economical means for the general distribution and utilization of energy."

THE HEALTH COMMITTEE OF THE LEAGUE OF NATIONS

Dr. O. R. Eichel, director of the Division of Vital Statistics, on leave of absence and serving with the League of Nations, reports the following interview with Surgeon-General H. S. Cumming, chief of the United States Public Health Service, and U. S. Representative on the League Health Committee:

I am one of the ten members appointed by the International Health Office to the League Committee under the new arrangement just concluded between the two bodies. The close coordination of international public health work that has been made possible by the partial amalgamation of the two bodies is to be welcomed as a great step forward. I have been keenly interested in effecting this reform since 1919, for the previous situation bordered on the absurd. Practically the same representatives of practically the same governments (except the United States, which was a member of the office and not of the committee, and Japan, which was a member of the committee but not of the office) met and worked separately. Most of these anomalies have now been

abolished under the new arrangement, much to the benefit of public health.

The United States Government is very much interested in the opium question, especially so in view of the conference this fall for cutting down the production and manufacture of opium to the amounts needed for medical and scientific purposes. In this connection the figures of 450 milligrams of raw opium per head per year suggested by the League Health Committee is extremely valuable, for it gives us something to go on. However rough and tentative an estimate the figure represents, it is a first step to a solution of the problem. We are at present collecting data in the United States on our annual requirements for medical and scientific purposes, as a contribution to this enquiry.

The proposal of the health committee that a central bureau of epidemiological intelligence should be established in the Far East is an excellent thing, and the selection of Singapore as a site is an excellent choice that was made on the merits of the matter and not on political grounds. The Straits are a funnel through which practically all shipping bound east or west passes; the geographical position is central; wireless communications are good and the port is right on the harbor.

The proposal for a Far Eastern sanitary convention shows above all the crying need for bringing the Paris Sanitary Convention of 1912 up to date, when the proposed Far Eastern Convention could easily be incorporated as a special chapter in the new general convention.

The progress of malaria in Eastern Europe has become a grave international problem, particularly in the Balkans, Southern Russia and Turkey, and the enquiry in these areas that is about to be undertaken by a League Committee will be most valuable. The committee is composed of extremely able men, and the United States will be much interested in the work it accomplishes.

Lastly, I would say that the system of "interchanges" by which medical officers of health from many countries are enabled to study health problems in and establish personal contact with colleagues from other countries is extremely valuable. The development and consolidation of this branch of work is one of the most valuable things the league has done from the point of view of public health.

THE NATIONAL PHYSICAL LABORATORY

THE annual report of the National Physical Laboratory, London, signed by Sir Arthur Schuster, chairman of the executive committee, gives as summarized in the London *Times* full particulars of the work of the laboratory during 1923, under the following heads:

(1) General research; (2) maintenance of standards; (3) research carried out by the laboratory for the coordinating research boards and committees of the Department of Scientific and Industrial Research; (4) investigations and tests for which payment is made by other government departments; (5) investigations and tests carried out for payment by firms and other bodies.

The report states that the past year has been characterized by a steady growth of work in all departments of the laboratory. This has been mainly due to the demands made upon the laboratory from outside, and in particular to the requirements of other government departments. Owing to the general business depression there was a slight falling off in work for firms, as compared with the preceding year, but towards the end of the year this work also showed a tendency to recover. The growth of the work involved considerable pressure on the staff, and necessitated increase in the staff in nearly all departments.

The work comprised under the heading of maintenance of standards constitutes one of the most important functions of the laboratory. The Board of Trade is responsible for the custody of the primary British standards of length and mass and for arranging certain periodical intercomparisons of these standards. At the request of the Board of Trade, the laboratory has recently undertaken the duty of making these intercomparisons on their behalf so long as the Superintendent of the Metrology Department continues to act as Deputy-Warden of the Standards. The close relationship thus established between the standards department of the board and the laboratory is expected to be of great value in maintaining uniformity in the fundamental measurements of length and mass. With reference to the resolutions adopted by the International Committee of Weights and Measures, the Department of Scientific and Industrial Research has also been requested by the Board of Trade to undertake an investigation into the use of a wavelength of light as a standard of length. This investigation was already included in the laboratory program for the current year, and, in response to the request of the board, steps have been taken to secure that the work shall be advanced as rapidly as possible.

Satisfactory progress has been made during the year with work on the fundamental electrical standards. The construction of the new cylinders for the ampere balance has been proceeding steadily, and it is hoped that these will be completed during the coming year. A series of comparisons has been made between one of the standard wire coils of the laboratory and the mercury ohm; for the realization of the latter the tubes used in 1912 by Mr. F. E. Smith have been again employed. The comparisons indicate that a slight increase in the dimensions of the tubes may have taken place, and the tubes are being recalibrated to check this supposition. Work on the new Schuster-Smith magnetometer is also well advanced.

The work undertaken for boards and committees of the Department of Scientific and Industrial Research has greatly increased, and a further considerable increase is anticipated during the year 1924–25. This,

the report says, is largely due to the activities of the research boards of the department in the coordination of work required by various government departments. It is manifest that this work must be expected to develop, and that the needs are most economically met by extending the facilities for research in existing institutions. The more important items of work recently undertaken by the laboratory for the coordinating research boards include a research on motor springs, and spring materials generally, which is of great importance to the War Office and other departments in respect of transport problems; an investigation into the properties of constructional materials at high temperatures; a research on big-end bearings desired by the Air Ministry, which is of general importance for high-speed engine design; experiments to determine a suitable yellow glass for railway signal lights, as well as colored glasses for ships and aircraft lights; and an investigation relating to pivots and jewels as employed in a variety of instruments of importance for naval, military and other purposes.

In the Radiology Division, a large number of tests have been made on X-ray protective materials, and a considerable amount of time has been devoted, as already mentioned, to the very important work of inspecting X-ray installations in hospitals. Good progress has nevertheless been made with a number of interesting researches, including an investigation into the scattering of gamma rays by matter, the excitation of X-ray bulbs by different high-tension generators, the relation between total and "local" ionization, the scattering of cathode particles when allowed to fall on different substances, and the structure of metallic crystals.

In the Optics Division, the main item of research for the year has been that connected with color standardization and spectrophotometry. Much attention has been directed to the problem of producing a satisfactory laboratory source of white light, for which a solution has not yet been found.

In the Photometry Division, the investigation into problems of illumination of buildings, originally undertaken for the Office of Works, has been extended to the study of daylight illumination, and much interesting work has been done. Experiments are in progress to determine the best arrangement of windows for one of the proposed galleries to be constructed in the new wing of the Tate Gallery.

EXPEDITION OF THE BISHOP MUSEUM

The Bishop Museum will have at its disposal for the next two or three years the four-masted schooner *Kaimiloa* for research work in the South Seas. The boat will leave Honolulu on its first cruise about the middle of October. The first year's tentative schedule includes Malden, Starbuck, Tangareva, Rakahanga, Manihiki, Pukapuka and Manua Islands, and if conditions permit considerable time will be spent in the Tuamotus.

On the initial cruise, six members of the museum staff will constitute the scientific personnel: Stanley C. Ball, curator of collections; Kenneth P. Emory, ethnologist; Charles H. Edmondson, zoologist; Armstrong Sperry, assistant ethnologist and artist; Gerrit P. Wilder, associate in botany; and Mrs. Wilder, interpreter. The scientists will be guests of the owners of the *Kaimiloa,* Mr. and Mrs. Med R. Kellum, who will accompany the cruise on some of its expeditions. The personnel of the later trips has not yet been selected.

The museum plans to study the out-of-the-way islands of the Pacific, making botanical, zoological and geographical studies, but giving particular attention to an ethnological study of the natives. It is hoped that relations may be established between the museum and the residents of the islands which will pave the way for a broad scientific survey in the near future, and lead to betterment of conditions under which the natives live.

The schooner has a length of 200 feet and a 38-foot beam. It has been remodelled to meet the needs of the scientists, and will carry a fully equipped laboratory, wireless apparatus, refrigerating plant, a library and spacious comfortable living quarters.

SCIENTIFIC NOTES AND NEWS

The centenary celebration of the founding of the Franklin Institute and the inauguration exercises of the Bartol Research Foundation open on September 17 with an address of welcome by the mayor of Philadelphia, and addresses by Dr. Wm. E. L. Eglin, president of the institute, and Professor Elihu Thomson, honorary chairman of the celebration committee. The program, printed in Science for August 8, contains the names of a large number of scientific men who are to give addresses, including the following from abroad: Sir Ernest Rutherford, Sir William Bragg, Professor W. L. Bragg, Professor E. G. Coker, Professor F. G. Donnan, Sir Charles Parsons, Professor J. S. E. Townsend, Professor Charles Fabry, Professor F. Haber and Professor P. Zeeman.

Dean Hugh Miller, dean of engineering in George Washington University, has been elected to be secretary of the engineering section of the American Association for the Advancement of Science, to complete the present term. Mr. L. W. Wallace, who has been secretary of the section for several years, found it necessary to resign on account of other duties. Correspondence regarding the engineering section should be addressed to Dean Miller.

DR. SHIRO TASHIRO, associate professor of biochemistry at the University of Cincinnati College of Medicine, who was awarded the Gakushün prize by the Imperial Academy of Arts and Sciences of Japan, has received from the Imperial University of Kioto the honorary degree of doctor of medical science.

THE British Institution of Mechanical Engineers has conferred an honorary membership upon President Fred R. Low, of the American Society of Mechanical Engineers.

THE University of Wales has conferred the honorary degree of M.Sc. on Dr. H. Drinkwater, of Wrexham, in recognition of his research in genetics and on the British flora, and that of LL.D. on Sir Donald MacAlister, Bt., on account of his distinguished services to medical science and as a university administrator.

DR. E. E. FREE, formerly of the United States Department of Agriculture, has assumed the editorship in chief of *The Scientific American,* filling the vacancy created by the resignation of Austin C. Lescarboura.

DR. CHARLES W. GOULD, of New York, has been elected president of the National Eugenics Research Association.

THE astronomer-royal, Sir Frank Dyson, has been appointed president of the Greenwich branch of the League of Nations Union, in succession to Sir Charles Stone.

GEORGE L. CLARK, formerly a National Research Fellow at Harvard University, has joined the staff of the research laboratory of applied chemistry at the Massachusetts Institute of Technology.

HAROLD ALMERT, consulting engineer, of Chicago, a charter member of the American Association of Engineers, was elected president of that organization at the recent annual meeting in San Francisco.

H. C. BERGER, formerly of the research staff, Bureau of Mines, has been appointed research chemist at the Gloucester plant of the Armstrong Cork & Insulation Co.

DR. DAVID FRASER HARRIS, professor of physiology at the Dalhousie University Faculty of Medicine, Halifax, Nova Scotia, has resigned.

J. H. MAIDEN, who for nearly twenty years has been government botanist of New South Wales and director of the Sydney Botanic Gardens, has retired under the age-limit.

ACCORDING to wireless messages the schooner *Bowdoin,* bearing the explorer Donald B. MacMillan and his party, arrived at Godthaab, Greenland, on August 28, with all on board well.

PROFESSOR HERBERT FREUNDLICH, of the Kaiser Wilhelm Institute, will be the foreign guest of honor at the third Colloid Symposium which is to be held at the University of Minnesota next June.

DR. VINCENT G. BABECKI, who will teach in the new school of public health being organized at Warsaw, and Dr. C. F. Chellappah, medical officer of health of the Government Sanitation Department of Ceylon, are studying public health administration in the United States as guests of the International Health Board.

BARON RODOLPHE DE SCHAUENSSE, Professor Joseph McGoldrick, Henry Norris and Alec Besso, returned on September 1 from Brazil, where they have been collecting birds and other animals under the auspices of the Philadelphia Zoological Society and the Academy of Natural Sciences of Philadelphia.

THE dedication and unveiling of a monument in memory of Dr. William Thomas Green Morton, who was the first to administer ether for a surgical operation publicly at the Massachusetts General Hospital, October 16, 1846, took place at Charlton, Massachusetts, his birthplace, on September 1.

A COMMITTEE has been formed in Chicago, with Dr. Frank Billings as chairman, charged with the collection of funds for the erection of a monument to Pasteur. The monument, to be executed by the French sculptor, M. Léon Hermant, will be constructed of stone or bronze at a cost of $30,000.

A MONUMENT in honor of the late Professor Grasset, the well known neurologist of Montpelier, was recently unveiled at Lamalou-les-Bains.

WILLIAM DANIEL HURD, for ten years director of extension service at the Massachusetts Agricultural College and western manager of the soil improvement committee of the National Fertilizer Association, has died in his forty-ninth year.

DR. ROBERT KIDSON, F.R.S., the distinguished British paleobotanist, died on July 13 at the age of seventy-two years.

DR. R. H. JUDE, for more than thirty years in charge of the mathematical and physical department of Rutherford College, England, has died, aged seventy-one years.

PROFESSOR P. NATORP, emeritus professor of philosophy in the University of Marburg, author of "The Logical Foundations of the Exact Sciences," and leader of the neo-Kantian school, has died, aged seventy years.

DR. ALOIS MRÁZEK, professor of zoology in the Charles (Bohemian) University of Prague, died on November 26, 1923, aged fifty-six years.

PROFESSOR ALBERT HESSE, German chemist and for

over twenty years editor of the *Chemische Zentralblatt*, died on May 10, aged fifty-seven years.

Professor Luzzatto, reader in microscopy and biochemistry in the University of Ferrara, Italy, died on July 13 at the age of fifty years.

Dr. M. Palagyi, formerly professor of biology and natural philosophy in the University of Klausenburg and later professor at Budapest, has died, at the age of sixty-four years.

The centennial of Charcot coincides with the twenty-fifth anniversary of the founding of the French Société de neurologie, and is to be celebrated by the Réunion annuelle de neurologie, announced for June, 1925. According to the *Journal* of the American Medical Association, two topics have been selected for discussion: "Migraine," to be introduced by V. Christiansen, of Copenhagen, and Pasteur Vallery-Radot, of Paris, and "Charcot's Disease" by V. Neri, Bologna; Van Bogaert, Antwerp, and I. Bertrand, Paris.

The second Spanish Congress of Medical Science will be held at Seville next October.

According to the *British Medical Journal* the Dutch Medical Association, which consists of sixty divisions with a membership of 3,373, or about 90 per cent. of all the practitioners in Holland, has celebrated its diamond jubilee by the issue of a memorial volume containing papers on Dutch medicine before the foundation of the association, Dr. A. F. H. de Lespinasse (its founder), the origin of the association, and the history of its library. The volume contains numerous portraits of officers of the association, including Drs. Daniels, Donders, Pel, Snellen, Stokvis, Treub and Wenckebach, as well as full-page illustrations from some of the rarer works in the association library.

The thirteenth annual safety congress of the National Safety Council will be held at Louisville, Ky., September 29 to October 3. The *Journal* of the American Medical Association states that among others, the following addresses will be presented: "Industrial health as a purchasable commodity," Dr. Clare F. N. Schram, medical director, Fairbanks Morse and Company, "Health education of our foreign families," Dr. Amos W. Colcord, Carnegie Steel Company, "How to make a sanitary survey of an industrial plant," Dr. Charles L. Ferguson, Shelby Shoe Company, "Report of committee on benzol poisoning," Charles Edward A. Winslow, "Prevention of lead poisoning" (round table discussion), Dr. Wade Wright, assistant medical director, Metropolitan Life Insurance Company, and Frederick L. Hoffman, Babson Institute, Mass., "How a medical department may contribute to safety in the chemical industry," Dr. Benjamin J. Slater, Eastman Kodak Company, Rochester, N. Y.

A prize for the physiology and pathology of altitude has been founded by the Alpine Sanatorium of Semmering, Austria. According to *Nature*, one thousand gold krone are offered to the author of the best work accomplished or published in the last two years, which has extended our knowledge of the action of alpine climate on man. The prize is intended in the first instance for Austrians, but foreigners can also be considered if their work has been carried out in Austria.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of J. J. Arakelyan various colleges in this country and Turkey will benefit as follows: Constantinople College, Turkey, $10,000; Robert College, Turkey, $10,000; American University of Beirut, Turkey, $10,000; Berea College, $10,000; Piedmont College, $10,000; Gordon Bible College, $10,000; president and fellows of Harvard, $15,000; Antioch College, Ohio, $10,000; Atlanta Theological Seminary, Georgia, $5,000.

Three thousand acres of land in Albania have been given to a new American college in that country by the Albanian Government, to be called the American-Albanian College of Agriculture and Trades. C. Telford Rickson has become president of the institution.

Dr. Keozo-Dohi, of the Tokyo Imperial University, has contributed $25,000 and his students and colleagues $7,500 for the establishment of a dermatologic museum at the university to celebrate his twenty-fifth anniversary as professor of dermatology.

The Bethlem Royal Hospital has been admitted as a school of the University of London in the faculty of medicine for the purpose of research in psychological medicine.

The new pathology building of McGill University Faculty of Medicine, Montreal, will be officially opened on Founder's Day, October 6, in the presence of leading pathologists of Great Britain, Canada and the United States.

Dr. Hawley O. Taylor, recently head of the electrical department of Franklin Union, Boston, Mass., and formerly consulting physicist, Bureau of Standards, Washington, D. C., has been appointed head of the physics department of John Brown University, Sulphur Springs, Arkansas, a new institution which opens its doors this autumn.

Dr. Eugene R. Whitmore, professor of bacteriology and preventive medicine in George Washington Medical School, has been appointed professor of bac-

teriology and pathology in Georgetown University Medical School and pathologist to Georgetown University Hospital, Washington, D. C.

Dr. Gerald L. Wendt has resigned his position with the Standard Oil Company to take the position of dean of the school of chemistry and physics at the Pennsylvania State College.

Dr. L. W. Durrell, formerly assistant plant pathologist at the Iowa Agricultural Experiment Station, has been appointed head of the department of botany of the Colorado State Agricultural College.

A. A. Packard, instructor in physics at Syracuse University, has been appointed assistant professor of physics and mathematics at St. Stephens College, Annandale-on-Hudson, N. Y.

Dr. C. C. MacDuffee, assistant professor of mathematics at Princeton University, has accepted an assistant professorship of mathematics at the Ohio State University.

Dr. Donald A. Laird, National Research Fellow in Psychology, has been appointed associate professor of psychology at Colgate University.

Dr. David Murray Lyon, assistant physician to the Royal Infirmary, Edinburgh, has been appointed Christison professor of therapeutics in the University of Edinburgh in succession to Dr. J. C. Meakins, who has become professor of medicine at McGill University.

Professor W. J. de Haas, of Groningen, has been appointed to succeed Professor H. Kamerlingh Onnes, of Leyden, who has resigned.

DISCUSSION AND CORRESPONDENCE

AMERICAN USES OF GLOBES BEFORE 1800

In reviewing the beautiful and instructive work on "Celestial and Terrestrial Globes,"[1] by Stevenson, I ventured the assertion that undoubtedly American discussions of globes could be found in the period before 1800, to which Dr. Stevenson confines his discussion. Colonial references are fairly numerous and as it may stimulate some further explanation along this line in this interesting period of American history I list here a few of the references which have come to my attention.

In 1753 Theophilus Grew, a professor at the academy in Philadelphia which has become the University of Pennsylvania, published a treatise on globes. The title reads:

> *The Description* and *Use* of the *Globes*, Celestial and Terrestrial; With Variety for *Examples* For the Learner's *Exercises*: Intended for the Use of such Persons as would attain to the Knowledge of those *Instruments; But* Chiefly designed for the *Instruction* of the young *Gentlemen* at the *Aca-demy* in Philadelphia. To which is added *Rules* for working all the Cases in Plain and Spherical Triangles without a Scheme. By *Theophilus Grew,* Mathematical Professor. Germantown, Printed by *Christopher Sower,* 1753 [pp. 60, (2)].

Copies of the work are found in the Pennsylvania Historical Society Library[2] and in the library of the University of Pennsylvania.

After 16 pages of description Grew takes up the common problems on the use of both globes (pp. 17–45). A treatise on plane and spherical trigonometry is probably the earliest published in the United States. This begins with right triangles (pp. 46–47); oblique angled plain triangles (pp. 48–50); right angled spherical triangles (pp. 50–55), and oblique angled spherical triangles (pp. 55–60).

This little printed work is evidence of the widespread interest in globes in the colonies. Washington had a terrestrial globe in his library, now in the Mount Vernon Museum. Unfortunately the globe is in need of repairs and the name of the make could not be deciphered by the Custodian of the Museum, who courteously gave me information concerning it. Benjamin Franklin ("Writings," ed. A. H. Smith: Vol. III, New York, 1905, pp. 89–91) in writing on June 20, 1752, to his London correspondent, William Strahan, ordered a pair of globes.

> Please send me another of Popple's Maps of North America . . .; a Pair of Mrs. Senex's improved Globes, . . . (or Neal's improv'd Globes, if thought better than Senex's) the best and largest that may be had for (not exceeding) Eight Guineas.

In the *Kentucky Gazette* of May 23, 1789, Jeremiah Moriarty advertises that he "will teach dancing. Teaches geography and use of the globes, having a pair on a new construction with Captain Cook's discoveries."

In New England one would expect a lively interest in the subject; works on surveying, navigation and travel were in great demand. An able mathematician, Nathan Prince, of Harvard, advertised in the Boston *Evening Post* of Monday, April 4, 1743, that he proposes "on suitable Encouragement, to open a School . . . for the instructing of young Gentlemen in . . . Mathematicks . . . Geometry . . . Algebra . . . in Trigonometry and Navigation; in Geography and Astronomy, With the Use of the Globes, and the several kinds of Projecting the Sphere. . . .

[1] Science, Vol. 56, pp. 199–201, August 18, 1922.

[2] The writer is indebted to the librarian, Dr. Montgomery, for loaning this copy to the William L. Clements Library for his use.

American geographies like that of Payne (New York, 1798) commonly included sections on the globes. Payne discusses (Vol. I, pp. xxxiii–xxxviii) "Problems performed by the globe; Jedidiah Morse (American Geography, 3d ed'n, Boston, 1796) gives a ten-page discussion, with problems, on both Terrestrial and Celestial globes, and the same space is devoted to this topic in the first American edition (Philadelphia, 1794) of Guthries's Geography. It is worthy of note that David Rittenhouse contributed to the astronomical portion of the American edition.

The first astronomical book printed in America was the "Phisica, Speculatio . . . Accessit compendium sphere Campani," by Alonzo de Vera Cruz (Mexico, 1557). An examination of this work and later Mexican works in astronomy and geography would be likely to reveal some use of globes in Spanish America.

These notes are intended to indicate some of the various sources of information concerning early American uses of the globes and also their intimate connection with early astronomy and mathematics in the New World.

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ON THE EXCRETORY APPARATUS IN PARAMECIUM

CERTAIN observations[1] on the morphology of the contractile vacuole and feeding canals in *Paramecium caudatum* warrant the following conclusions:

The pore, contractile vacuole and canals (eight to eleven in number) form a continuous, permanent ectoplasmic *structure*. There is here, therefore, neither evidence of nor necessity for a sol-gel reversibility of the cytoplasm, as set forth by Taylor ('23) to explain the mechanism of the contractile vacuole in *Euplotes*.

In a longitudinal section through the cortex, at right angles to a perpendicular line drawn through the pore to the bottom of the vacuole, the pore is seen on the surface as a clear, circular opening continuous with the vacuole below, showing no intervening membrane. Longitudinal and cross sections through the axis of pore and vacuole also show that the pore and vacuole are continuous. The vacuole can be distinguished in all stages of systole and diastole so far observed. During the stage of maximum contraction it is a minute central space with delicate radiating tubes, each of which leads to the bulbous end of a feeding canal. As the canals give up their contents to the vacuole, the vacuole gradually increases in size; meanwhile, the bore of the canals diminishes. The distention of the vacuole in stages of diastole is at the expense of the proximal ends of the feeding canals. Thus, the walls of the canals are directly continuous with the wall of the vacuole. The pore, vacuole and canals make a permanent continuous structure.

The canals are slender tubes varying in extent and size according to their disposition and the stage of contraction of the vacuole. At the end of systole, when the vacuole may be said to be collapsed, each canal is markedly bulbous in that portion immediately distal to the radiation from the vacuole. In such a stage the canals may be likened to long-handled Indian clubs radially disposed with their bulbous ends in close proximity. As diastole progresses, the canals present more nearly parallel sides throughout their length. Toward the end of diastole and the beginning of systole, the canals show distentions farther away from the vacuole.

There is no evidence that the contractile vacuole is formed by accessory vacuoles, as described and figured by Khainsky ('10), nor does any section show a pulsatorial papilla or evagination, such as he describes.

This study, therefore, indicates that the excretory apparatus of *Paramecium caudatum* is a permanent, continuous *structure*.

A detailed account with illustrations will be published later.

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[1] These observations were largely on serial sections of Paramecia fixed with Gilson, Bouin, Meves, Benda, Flemming and Altmann among others, including solutions of iodides (*e.g.*, Lugol's and 2 per cent. anhydrous iodic acid). The Altmann fixation gave by far the best results: absolutely no shrinkage; mitochondria, oil drops and cilia perfectly preserved. Of the various staining methods used, iron hematoxylin gave the best results. I am indebted to Dr. E. E. Just for turning over to me these slides, study of which served as a basis for these observations.

THE RESISTANCE OF THE TYPHOID BACILLUS TO FREEZING

IN spite of the published work of Pearse, Sedgwick and Winslow, Park and North, most text-books on bacteriology state that Eb. typhi will resist freezing for a considerable time; and quote Taylor's investigation of the historic Plymouth epidemic in support of their views.

In a series of experiments conducted in this laboratory during the past year, Mr. W. A. Kreidler, a graduate student, obtained results which clearly indicate that this hypothesis is incorrect. Using artificial culture media, water, sterile and normal feces as the media in which the organisms were frozen, he was unable to obtain any growth of typhoid bacilli or the "Paras" after freezing for three weeks.

While we must realize that we can not exactly simulate natural conditions in the laboratory, it would seem that organisms which had been leading a saprogenic life for years would be more resistant to the conditions of the experiment than would the same organisms in a highly virulent parasitic condition.

The Plymouth typhoid epidemic was caused by a fresh and vigorous strain, as is indicated by the severity of the early cases. It is not likely, therefore, that it was caused by organisms which had been in a frozen medium for any length of time. I would suggest the theory that the epidemic was caused by the organisms in the feces which were deposited within a few days of the time the reservoir was opened, about the time of, or after, the thaw.

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ANALYZED SOUND

IN the issue of SCIENCE for July 4, 1924, an interesting discussion of "Analyzed sound" by Alexander Forbes appeared. This description of the several instances coming to his attention brought to mind an experience of mine with a similar phenomenon occurring at Oxford, Massachusetts, many years ago. Having very carefully kept journal records almost daily since 1898 of my thoughts, experiences, etc., in contact with all natural phenomena, I made a search of my journal and found the following record which I will copy just as written:

Aug. 11, 1902. Oxford, Mass.

As an early train passed by this morning, I noted a most remarkable echo every time it whistled. The first echo was immediate, sharp and distinct, appearing to rebound from a neighbor's buildings nearby. Some seconds after all was quiet, another faint, far-away musical echo came stealing up the valley, apparently emanating from a wooded hillside far away. The echo ever increased in intensity until it seemed to pervade every corner of the landscape, filling it with a wonderful harmony of sound that beat upon the air in ever fainter waves, ever becoming farther away, until the sounds could no longer be heard. At no time were the sounds loud but seemed to fall upon the ear in infinite waves, as if thrown back from some invisible dome overhead. It did not seem to be a terrestrial echo, but seemed to fill the skies overhead with sweet, spiritual sounds, that seemed also to reecho far back in the skies, one could not tell where. I think some obscure atmospheric condition overhead was responsible for this remarkable echo, the most exquisite, the most sweetly celestial sound I have ever heard in the skies.

At the time I was greatly impressed with this remarkable sound phenomenon, but I have never since heard anything even approaching this strange breaking up and reflection of a sound into musical tones such as occurred in this instance.

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IN connection with the article in SCIENCE of July 4, 1924 (page 5), on "Analyzed Sound," attention should be called to Lord Rayleigh's discussion of the phenomena half a century ago (*Nature,* 1873, Vol. VIII; "Theory of Sound," Chap. XV) under the title "Harmonic echoes." His conclusions from a mathematical investigation of the reflection of sound-waves from small surfaces, as tree trunks, were that the intensity of the reflected wave varied inversely as the fourth power of the wave length. The overtones in the echo of the voice would therefore be very much stronger relatively to the fundamental than in the original sounds and the effect might easily be called a change to the octave.

Many years ago there was such an echo at the Adirondack resort, Loon Lake, Franklin County, N. Y.

CHARLES K. WEAD
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SCIENTIFIC BOOKS

Extinct Plants and Problems of Evolution. By D. H. SCOTT. Pp. xiv + 240. Macmillan & Co. London, 1924.

THIS little book, founded upon a course of lectures given at the University College of Wales in 1922, is a largely non-technical and very readable account of the main points in our knowledge of fossil plants, written for the non-specialist.

The first chapter is an all too brief, but very illuminating, sketch of the present status of the various theories that have been advanced to explain the facts of evolution. A consideration of extinct floras is preceded by a very brief sketch of recent floras, and the former are taken up in the sequence from youngest to oldest. The great transformation periods of floral history are considered to have been the middle Devonian, the Permian and the mid-Cretaceous, ushering in respectively the so-called Carboniferous flora, the Mesozoic flora and the flowering plants. The consideration of the early Devonian flora is almost entirely devoted to considerations growing out of the recently discovered petrified material in the Rhynie chert, and showing certain bryophytic and algal characteristics. It seems to the reviewer that a somewhat misleading impression is given of the extent of the Permian transformation, which was really a gradual process when viewed in the true geological perspective. The consideration of the Mesozoic floras is

largely taken up with the Cycadophytes, and the author is seemingly greatly impressed with the analogies between the bisporangiate fructifications of the latter and those of certain angiosperms. The treatment of the flowering plants is very brief and, although avowedly incomplete, does not indicate any great knowledge of, or even interest in, the literature of the subject.

As is eminently proper in a book designed for a general audience, the author very fairly states all controverted questions and rightly refrains from arriving at decisions, which are indeed impossible in the present state of our knowledge. Without prejudice to his position he may, I think, be fairly said to favor the following propositions: That land plants probably arose from various specialized algal ancestors somewhat after the manner set forth in Church's speculations; that the vascular plants were consequently polyphyletic in origin and that the Rhyniaceae may have been reduction products of some algal stock; that the true ferns and the seed ferns were of independent origin; that there was a community of origin between the seed ferns and the Cordiatales, and that the conifers and the ginkgos took their origin from some cordiatalean-like ancestors; that there was a community of origin between the flowering plants and the Mesozoic cycadeoids, finally that on the whole the evidence is favorable to the truly Darwinian conception of an orderly and gradual evolution of the various plant phylae.

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SPECIAL ARTICLES

A MECHANISM FOR THE COORDINATION AND REGULATION OF THE MOVEMENT OF CILIA OF EPITHELIA

THAT the movement of cilia in epithelia is coordinated is a fact of universal observation, but a structural mechanism in epithelia, by which this coordination of movement is conditioned and facilitated, has not hitherto been demonstrated.

Many biologists, especially physiologists, finding nothing in the structure of living epithelia suggestive of a coordinating mechanism and no reference in the literature of morphology concerning a durable, structural organization adequate to account for coordination of ciliary movement, have concluded that such a mechanism is not essential and does not exist. To account for the observed coordination of ciliary movement in epithelia, G. H. Parker,[1] in 1919, definitely formulated his theory of "neuroid transmission" according to which the coordinating impulses that pass from cilium to cilium are conducted, not by structurally differentiated paths, but by virtue of "that elemental property of protoplasmic transmission from which true nervous activity has been evolved." According to Parker ciliated epithelia present favorable conditions for the study of this elemental form of transmission.

The regulation and control of ciliary movement, such that it is correlated with the changing conditions of the environment and physiological states of the organism, is also a fact that is established by observation and experiment, although there are biologists who assert that such regulation does not exist; ciliated epithelia, according to their view, being purely automatic in their movements and not adjustable to the changing states of the organism as a whole. J. L. Kellogg[2] holds to such a view, at least so far as the ciliated tracts of the palps of lamellibranch mollusks are concerned.

During the past year we have made careful cytological studies of ciliated cells and epithelial of the gills of several species of fresh-water mussels of the genera, Lampsilis and Quadrula, and have been successful in finding well-differentiated systems of fibers which fully satisfy all the requirements of coordinating and regulating mechanisms.

The differentiated mechanism we have been able to demonstrate in the latero-frontal ciliated epithelium of the gill of a species of Lampsilis is shown in Fig. 1, and is schematically represented in Fig. 2.

The cilia (C), in this type of epithelium, are paired, and members of pairs are fused at their tips (X). The number of pairs of cilia is approximately the same as the number of nuclei in the syncytial epithelium. A specialized cuticle is present at the external surface of the epithelium in which the cilia and their basal corpuscles (b) are implanted. In the proximal zone of cytoplasm, between the cuticle and the row of nuclei, a system of intra-cellular fibers or ciliary rootlets is chiefly distributed, although fibers belonging to the system may penetrate the cytoplasm between nuclei, and perhaps even to the basement membrane and the sub-epithelial layer of bipolar cells. This system of intra-cellular fibers may be analyzed as follows: each cilium splits, just below its basal corpuscle, into two fibers (m and n) which diverge at angles varying from 20 to 30 degrees, one to the right and one to the left in the plane of the row of cilia. The right hand branches (m and m′), originating from the members of a pair of cilia,

[1] G. H. Parker, "The elementary nervous system," Lippincott Company, 1919.

[2] J. L. Kellogg, "Ciliary mechanisms of lamellibranchs, with descriptions of anatomy," *Journ. Morph.*, Vol. 26, 1915.

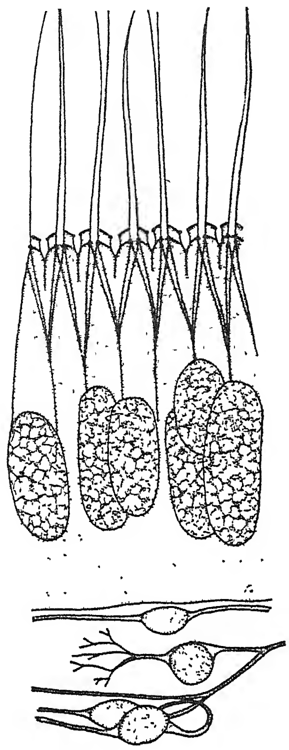

FIG. 1

gradually converge and join to form a single fiber (o), while the left hand branches (n and n′), join to form the fiber (o′). The fibers (o and o′) join with corresponding fibers derived from adjacent pairs of cilia, to form the fibers (p and p′) which may end on the nuclear membrane or penetrate the cytoplasm between nuclei. The part of this system, consisting of the fibers m, m′, n, n′, o and o′, forms a mechanism which is continuous throughout the extent of the epithelium and is postulated as that which provides a basis for the coordination of ciliary movement. The continuations of this system, through the fibers (p, p′, etc.) into the deeper parts of the epithelium, provide for the entry, into the system, of impulses, originating either in nuclei, the cytoplasm or bipolar cells of the subepithelium, by which movements of the cilia may be adaptively regulated in conformity with the state or needs of the organism as a whole.

In addition to the mechanism for the coordination of ciliary movement, just considered, another series of structures is present in each of the segments of the cuticle bounded by pairs of cilia, which apparently serves another purpose. One of these systems may be described as follows: a minute space (0) interrupts the continuity of the cuticle midway between pairs of cilia in the plane of the series of cilia. This space opens on the surface of the epithelium and, in section, appears to be formed between two fiber-like structures (r and l) which join the cuticular border above, in two-minute granules, and meet at the lower border of the cuticle, midway between the bases of the cilia of two pairs, in a similar granule. This latter granule is the meeting place also for two comparatively short, robust fibers (R and L) which originate, one from the nearest basal corpuscle of the pair of cilia on the right of the space, the other from the nearest basal corpuscle of the pair on the left, and it is the point of origin for a longer, unpaired, vertical fiber (S), which penetrates the cyto-

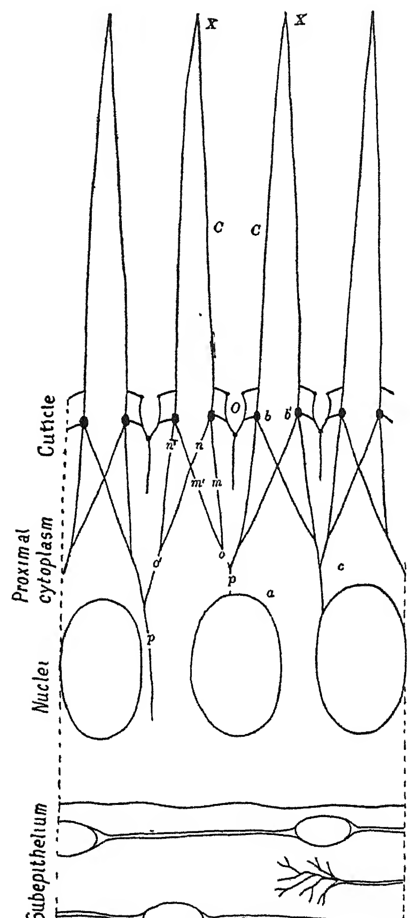

FIG. 2

plasm to a depth below the cuticle about twice the thickness of the cuticle. This series of cuticular structures requires further study. The fibers (R and L) may be interpreted to be a part of the mechanism for the coordination of ciliary movement. The spaces in the cuticle and their attendant fiber-like differentiations possibly represent a structural adaptation for taking up stresses and strains in the highly gelled cuticle incident to ciliary movement.

It may be too early to indulge in sweeping generalizations, but we venture to predict that similar structural differentiations will be found in all ciliated epithelia. The facts of comparative morphology justify such a prediction. Function is so universally found to be associated with, and to depend upon, definite structural organization of living substance that in a tissue so specialized in function as that of a ciliated epithelium we may expect *a priori* to find in it a corresponding structural differentiation that is neither indefinite in form nor of temporary duration.

The results of our investigation of various types of ciliated cells, which rest upon experimental as well as morphological evidence, will be fully reported and discussed in a paper to be published in the *Journal of Morphology and Physiology.*

CASWELL GRAVE,
FRANCIS O. SCHMITT
WASHINGTON UNIVERSITY,
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PRELIMINARY NOTE CONCERNING PHYSIOLOGICAL SPECIALIZATION IN FOMES PINICOLA FR.

THE idea of physiological specialization in the fungi has undergone extensive development during recent years. In fact, a considerable amount of literature on this subject has arisen since about 1890, and it has been demonstrated beyond all reasonable doubt that physiological specialization exists in a great number of fungi belonging to widely separated families. The rusts have received particular attention in regard to this point and many interesting as well as important facts have been brought to light by the work of Eriksson, Dietel, Stakman, Hungerford and others.

Other genera of fungi, as, for example, *Erysiphe, Glomerella, Sphaeropsis, Rhyzoctonia, Septoria* and many others, have also been investigated, but, as far as the writer is able to ascertain, little has been done along the line of physiological specialization in the case of the wood-destroying fungi. It is true that some work has been done on these forms, but the emphasis has been on the morphological rather than on the physiological aspects of the question.

In regard to their general life history, many of the wood-destroying fungi differ from most other fungi in that they may, as a result of a single infection, inhabit a single host plant for a great number of years. For example, it is not impossible, nor even improbable, that *Echinodontium tinctorium, Fomes pinicola, Trametes pini,* etc., may grow in a tree as a result of a single infection for twenty-five, fifty or even a greater number of years. If, then, the character and general properties of the host plant exert any influence on the fungi infecting it, tending to produce physiological specialization, strains or varieties, it would not seem unreasonable to suppose that the chances for the production of such specialized forms or varieties among the wood-destroying Basidiomycetes would be very good.

There is also a very important practical aspect to this question. It is usually considered, in addition to other reasons, very poor practice from the standpoint of forest sanitation to allow infected trees to remain standing on an area upon which it is expected to raise future forest crops, even though these infected trees are of a different genus than those to be grown eventually. A concrete case will serve to elucidate this point. The white pine stands of the Inland Empire contain a considerable number of inferior species, such as white fir and hemlock. These latter species are often heavily infected with heartrot and many of such infected trees remain standing on the area after logging operations are completed. This is particularly true if broadcast burning does not follow the logging operations. These infected trees remain on the area at least during the early growth of the second crop. Very often the same species of fungi which cause the heartrot in these remaining trees also cause heartrots in the trees with which it is hoped to restock the area, as, for example, white pine. Thus *Trametes pini* causes more or less similar heartrots in fir, spruce, larch and pine. *Fomes pinicola* causes a red brown sapwood rot in spruce, larch, fir, pine and hemlock. *Echinodontium tinctorium* causes a heartrot in practically all the western true firs, Engelmann spruce, Douglas fir and western hemlock. Many other examples might be given, but the above are sufficient to illustrate the point. It is generally assumed, therefore, that these infected trees remaining on the area after logging constitute a menace to the future forest crop, even though it may be of a different genus. If, on the other hand, physiological specialization has developed to the extent that the strain common to white fir is limited to white fir, the Douglas fir strain to Douglas fir, etc., it is evident that the expense of falling and destroying these infected remaining trees might be eliminated when the forest sanitation is the only factor necessary to consider. The writer volunteers no expression of opinion on this point at this time, but merely calls attention to the situation.

It must be obvious that artificial infection experiments with the heartrot fungi are especially difficult and that it would take many years before any reliable data could be obtained. However, studies can be made on the physiological characteristics of these forms which may at least indicate the desirability of undertaking such artificial infection experiments, no matter how difficult or time-consuming the work may be.

The present note reports the results obtained from a physiological study of four cultures of *Fomes pinicola* Fr. obtained from four different hosts, namely, Douglas fir (*Pseudotsuga taxifolia*), white fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*) and western white pine (*Pinus monticola*).

The results obtained show that these four strains of *Fomes pinicola* differ very markedly in (1) the characteristics of growth, (2) the rate of growth, (3) the extra-cellular enzyme activity, (4) the intra-cellular enzyme activity, (5) the effects produced in mixed cultures, (6) the growth on liquid media and (7) the nitrogen relations.

The wood-destroying properties are now under observation, but since these experiments require long incubation periods, the results will not be available for some time. A detailed discussion of the question of physiological specialization in *Fomes pinicola* will be published later.

HENRY SCHMITZ

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SERIES REGULARITIES IN THE SPARK SPECTRUM OF NITROGEN[1]

During the past decade the spectroscopy laboratory of the Bureau of Standards has been investigating the arc spectra of the elements as far into the infra-red as modern photographic methods will permit. This work has revealed the fact that certain lines appear on practically all the spectrograms regardless of what elements have been employed as electrodes in the arc. These lines were correctly attributed to the gases of the atmosphere in which the arc operated; and subsequent investigations of the spectra emitted by tubes containing oxygen, nitrogen, and argon have established the chemical origin of all the atmospheric lines which have been observed in the red and near infra-red regions. Preliminary wave lengths have already been published for these lines. (*Publ. Amer. Astron. Soc.*, 4, pp. 170 and 363; also, Merrill, *Astroph. Jl.*, 51, p. 236).

It is the purpose of this note to direct attention to the fact that the nitrogen lines which are observed most frequently and belong apparently to the category of sensitive lines, result from combinations of a triple p term with an s term, another triple p term, and with a five-fold d term. According to the alternation law of Kossel and Sommerfeld the spectrum of non-ionized nitrogen should exhibit series regularities of even structure, while the spectrum of ionized nitrogen, conforming to the displacement law, should exhibit structures of odd multiplicity. The series regu-

Term combination	λ I. A.	ν	Δν
S_2P_3	7468.74* (5)	13385.5	
			47.1
S_2P_2	7442.56 (4)	13432.6	
			33.7
S_2P_1	7423.88 (3)	13466.3	
P_3P_3	8216.46 (5)	12167.4	
			46.7
P_3P_2	8185.05 (3)	12214.1	
P_2P_3	8242.47 (3)	12129.0	
			46.5
P_2P_2	8210.94 (2)	12175.5	
			33.9
P_2P_1	8188.16 (3)	12209.4	
P_1P_2	8223.28 (3)	12157.3	
			33.6
P_1P_1	8200.59 (1)	12190.9	
P_3D_4	8680.35 (2)	11517.1	
P_3D_3	8718.99 (1)	11466.1	
			46.7
P_2D_3	8683.61 (2)	11512.8	
P_3D_2	——	(11428.7)	
			46.7
P_2D_2	8711.87 (1)	11475.4	
			33.7
P_1D_2	8686.38 (1)	11509.1	
P_2D_1	8729.07 (½)	11452.8	
			33.8
P_1D_1	8703.42 (1)	11486.6	
P_1D_0	——	——	

larities given in the accompanying table are of odd multiplicity (quintet system), and therefore belong to the spark spectrum of nitrogen. In the table, the first column gives the combining terms of which the inner quantum numbers are designated by subscripts, the second column gives the wave lengths and intensities of the lines, the third gives the vacuum wave numbers, and the fourth gives the wave-number separations of the common triple p term. The separations of all the polyfold terms involved follow approximately Landé's interval rule. Details of a more complete analysis of the spectrum will appear in a subsequent paper.

C. C. KIESS

BUREAU OF STANDARDS
AUGUST 14, 1924

[1] Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SECTION OF GEOLOGY

In addition to the report of the work of the section published in Science, January 25, the following papers may be noted:

Results of studies of glacial phenomena: Frank Leverett concludes that the boulders found in the Osage Valley in Missouri and for some distance south of the Kansas River represent a distinct projection of the ice sheet considerably beyond the limits formerly set for it. These boulders have been assigned to floating ice in the past. The till is regarded as of Nebraskan age. Similar conclusions were offered by Walter H. Schoewe, of the University of Kansas, who had carried on an independent investigation on part of the same area.

According to W. G. Waterman the glaciers in Glacier National Park are retreating rapidly. Sperry Glacier has retreated about 300 yards in 18 years, but by far the greater portion of this retreat has occurred since 1919.

Luella Owen presented the results of the last geological work of the late G. Frederick Wright. A comparison of the chemical characters of the loess of China with those of the loess of Missouri was made and the conclusion drawn from fossil and chemical evidence that the rock is of glacio-fluviatile origin. A striking illustration of the influence of glaciation on land values in Indiana was presented by Stephen S. Visher, who states that the average value of the land in the unglaciated portion of the state is about one half that of the land in the area covered by the Illinoisan ice sheet, about one third that of the land in the area covered by the Late Wisconsin sheet and about one third of that over which the Early Wisconsin sheet is spread.

A new relief map of Kentucky was announced by W. R. Jillson, who also described the fault pattern of Kentucky. In another paper a description of the cannel coals of the state was given. These coals are all of Pottsville age. The thicker seams are of comparatively limited areal extent, while the thinner ones extend over much wider areas. S. J. Hudnall offered a valuable correlation table for all coal seams in eastern Kentucky.

A description of the Cincinnati anticline by George D. Hubbard was followed by a paper by Lucien Becker, who presented evidence of the continuation of this structure across Mississippi, and of the possible continuance of slow uplift in this region at the present time.

Interesting examples of ebb and flow springs were discussed by Josiah Bridge, and the conclusion was reached that the peculiar variations in the flow of such springs is due to natural syphonic action. Walter H. Bucher described the unusual dome structures in Shelby County, Kentucky, as due to large bodies of magma intruded at considerable depth. T. L. Gledhill, in a paper on the nephelite syenites of the Sturgeon Lake District, Ontario, assigned their origin to pneumatolytic action, producing a progressive increase in soda. Soda-rich minerals are found replacing earlier minerals and the chemical analyses indicate an increase in soda with development of the later rocks.

Kilauea has always been regarded as a volcano of quiet type, but the studies of William H. Sherzer indicate at least four periods of explosive activity.

In his paper dealing with the teaching of elementary crystallography O. C. Von Schlichten emphasized the importance of a proper understanding of the value of internal structure in crystals, since this is the determining factor in external properties and the subject discussed in most of the recent texts on crystallography.

Arthur C. McFarlan offered a revised classification for the Chester species of the genus Archimedes and suggested that a classification be adopted, placing specific values on one axial and one frond type.

It would appear as though J. Ernest Carman had satisfactorily settled the vexed question of the dividing line between the Silurian and Devonian in Michigan. From a study of the Monroe in Ohio he concludes that the Detroit River dolomite and the Sylvania sandstone beneath it are Lower Devonian in age and that the Silurian-Devonian contact is at the base of the Sylvania sandstone. The evidence presented indicates: (1) That the geographical distribution of the several members of the Monroe in Ohio show that there was an early Monroe and a late Monroe advance of the sea separated by a recession in Middle Monroe; (2) The faunas of the Upper Monroe (Detroit River) and Lower Monroe (Bass Island) formations have very little in common—the Bass Island fauna is definitely Silurian, the Detroit River fauna is better interpreted as Devonian; (3) The Middle Monroe (Sylvania sandstone) is stratigraphically and faunally so closely related to the overlying Detroit River that whatever age is assigned to the Detroit River the Sylvania must go with it; (4) a disconformity and a distinct faunal change is located at the base of the Sylvania sandstone; and (5) a pocket of shale at the top of the Bass Island and apparently beneath the Sylvania sandstone contains distinctive Ostracoderms known elsewhere in the world only as basal Devonian.

E. S. Moore,
Secretary

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CONTENTS

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THE EVOLUTION OF INTERNATIONALISM[1]

THE evolution of internationalism is an interesting and very important study which will engage the attention of some of the best minds in the world more and more as time goes on. The interdependence of people and races of people is showing itself in new ways every year. The world is not yet overpopulated. In a strictly biological sense it will never be overpopulated by the human species or any other species. The old principle of "the balance of nature" is sure to prevail. The word *overpopulation* implies something unnatural—something beyond nature's laws—something that nature herself will correct; in other words, it is an impossible happening. Remember distinctly, please, that this is simply a broad biological deduction!

Yes, nature's restoration of the balance is inevitable. The species that have passed the great inexorable limit law must be reduced; the surplus must starve for lack of food. If the offending form should be the human species, with its wonderful intelligence, with the culture it has laboriously gained, with its high ideals, with its misty sense of spirituality, it will make no difference to nature; she will grind on and restore the balance.

The human species is utterly selfish, like any other species; but this selfishness tends to become more broadly a *species* selfishness as the years go by and conditions are more broadly understood, having passed through the stages of the selfishness of the individual, of the family, of the community, and, let us hope, of the nation—all successive stages, and all fundamentally based on the self-preservation instinct or desire of the individual, placed there by nature.

Love of kind is a late development, and love of kind in its purest form has been a powerful advocate leading forward to internationalism. But, just as the desire for continued existence with the individual has led to the evolution of the present social complex, to the growth of nations, so the continually increasing difficulties of existence lead onward to the species selfishness—the desire to maintain the human species in control of all resources of the planet on which it finds itself.

Thus, conservation of the world's resources, the movement which is expressed by this conference, attended as it is by many men of many nations, is an

[1] Opening remarks of the chairman of the First Pan-Pacific Conservation Congress, Honolulu, Hawaii, July, 1924.

idea based upon what may be termed *species* selfishness. The human species has a collective mind, and thus has an immense advantage over the other forms that have come into this world, and so, finding itself at war with its surroundings, it has an enormous advantage over other animals in being able to work out plans for the subjugation of nature, in being able to modify many forms of plant and animal life, in being able actually to domesticate many of them, as against the immensely slow working of the forces of adaptation acting with other species.

It is quite true that in the course of ages this evolutional adaptation has given the vastly older forms of life a very great advantage over the human species. Hundreds of thousands of species of insects, for example, are far better adapted to continued existence upon the earth than is the human species; but the birth of intelligence, of the human mind when it is put to collective use, places man in control and enables him, in spite of his poorly adapted physique, to assume the commanding place.

There are, of course, regions where the war against nature is less strenuous than in others, regions in which the fighting and resistant qualities have not been demanded as in other regions. Compare the conditions which were met by my own ancestors, when they landed on the frightful coast of New England three hundred years ago, with those met by the first visitors to some of these friendly islands of the Pacific. With the former, life was a keen struggle; with the latter, the environment of nature was friendly, smiling, welcoming.

The time has never been, however, when the interests of man everywhere have not been theoretically interdependent; and in the later years we have seen the great coming-together movement, the mutually helpful movement, take form and grow more and more rapidly. It is a movement which is daily becoming more necessary for the well-being of the human species. Just how important this is—just how necessary it is for the best minds of all nations to come together in international conservation conferences like this—becomes more appallingly obvious year by year as the world's population continues to increase at such a rate that ninety years hence it will have reached four billions.

In my own country, the United States, out of a total land area of 1,903,000,000 acres, 478,000,000 acres were in cultivation in 1910. One hundred million people are supported comfortably now, and 135,000,000 can be supported eventually if our agriculture is efficient. With the steadily increasing population (even without immigration) the present productivity must be increased 50 per cent. if our people in the very near future are to have the present food standard. This may be brought about by the irrigation of 30,000,000 acres of desert, by the drainage of 60,000,000 acres of swamps, by the utilization of 82,000,000 acres for dry farming; and part of our 150,000,000 acres of forests may have tillable land. Then, too, the food resources of our lakes, streams and ocean coast waters can be increased. The enormous loss to our agriculture from injurious insects and plant diseases can be and must be very greatly decreased. To-day we are planting thousands upon thousands of acres for the benefit of the insects rather than of ourselves. And the appalling waste that is still going on! That largely can be stopped.

Professor E. M. East, of Harvard, in a recent book entitled "Mankind at the Crossroads," points out that in a little over a century the earth may be inhabited by 5,200,000,000 people, and in such a case, he prophesies, "the world would be filled with a seething mass of discontented humanity struggling for mere existence." East argues that the fertile regions of temperate Asia and the major part of Europe are already overpopulated; that "North America is entering a stage when exportation of food is no longer possible; Australia will reach the same stage within a few decades, and temperate South America will follow Australia before the present generation passes on." His conclusion is, "Within half a century presumably, within a century certainly, each country must prepare to live upon the fruits of its own agricultural efforts."

Is this too dismal a picture? If so, what can be done to prevent this future? Scientific birth control has been advocated. To the biologist, that is a plan of many merits, which, could it ever generally be agreed upon and enforced, without doubt would make for the improvement of the human race and greatly would retard the arrival of the dreaded years of disastrous overcrowding.

But, aside from birth control, the sum of human intelligence, the cooperation of the best brains, the pushing of human inventiveness, will result not only in better conserving the world's resources for the benefit of humanity, but in increasing them in ways that are not dreamed about as yet. This is the idea that must be stressed from now on. This is the controlling idea of this conference. This is the idea which will bring the thinkers of many nations together with increasing frequency in the years to come. This is the idea which, in its fullest action, will preserve for the human species its present commanding place on this planet, let us hope for many centuries to come.

L. O. Howard

Honolulu, Hawaii

THE PAN-PACIFIC FOOD CONSERVATION CONFERENCE

THE Food Conservation Conference held at Honolulu July 31 to August 14, 1924, under the auspices of the Pan-Pacific Union, was an event of more than ordinary interest to every country bordering on the Pacific.

There were more than 140 delegates present, representing practically every country of the Pan-Pacific Union. Countries that were particularly well represented were New Zealand, Australia, the Netherlands, East Indies, Siam, China, Japan, the Philippines and the United States. Several of the delegates were men well known internationally; among these may be mentioned the Honorable George M. Thomson and the Honorable Mark Cohen, of New Zealand; Sir Joseph Carruthers, ex-premier of New South Wales; Dr. Hippolyte Damiens, administrator in chief of Indo-China; Dr. Rodrigo Rodrigues, governor of Macao; Dr. Hugh M. Smith, advisor in fisheries to the King of Siam; Dr. Koliang Yih, Chinese consul general at San Francisco; Dr. Ken Harada, secretary League of Nations; Dr. K. Kishinouye, professor of fisheries, Imperial University of Tokyo; Dr. Rokuichiro Matsujima, first president of the International Bar Association; Sanford B. Dole, first president of the Republic of Hawaii, and Dr. David Starr Jordan, international authority on fisheries.

Among the delegates and others in attendance from America may be mentioned the following: Dr. E. W. Allen, chief, Office of Experiment Station, U. S. Department of Agriculture, Washington, D. C.; Dr. Carl L. Alsberg, director Food Research Institute, Carnegie Corporation, Stanford University, California; John Pierce Anderson, Red Wing, Minnesota; Miss Louise A. Anderson, Red Wing, Minnesota; M. De Arango, chemical engineer, 67 Wall Street, New York; Dr. E. W. Brandes, pathologist in charge sugar plant investigations, U. S. Department of Agriculture, Washington, D. C.; Dr. F. A. Bushe, representing University of Colorado, Boulder, Colorado; Dr. Mary Page Campbell, California Academy of Sciences, San Francisco; Harry Chandler, representing Los Angeles Chamber of Commerce; Dr. Royal Norton Chapman, associate professor of animal biology and entomology, University of Minnesota; Dr. T. D. A. Cockerell, professor of zoology and entomology, University of Colorado; Hon. John C. Cope, Portland, Oregon; M. Viscount G. de la Jarrie, director of Bureau of French Colonial Information, New York; Miss Alice Eastwood, curator of botany, California Academy of Sciences; Dr. Henry A. Erikson, chairman, department of physics, University of Minnesota; Dr. Barton Warren Evermann, delegate representing the California Academy of Sciences, the Pacific Division of the American Association for the Advancement of Science and the San Francisco Chamber of Commerce; Dr. Fred Denton Fromme, professor of plant pathology and bacteriology, Virginia Polytechnic Institute, Blacksburg, Virginia; Dr. T. C. Frye, professor of botany, University of Washington; Dr. Ross Aiken Gortner, chief, division of biochemistry, University of Minnesota, representing the university and the Minnesota Agricultural Experiment Station; Dr. Lawrence E. Griffin, professor of biology, Reed College, representing Chamber of Commerce, Portland, Oregon; Dr. J. Arthur Harris, head department of botany, University of Minnesota; Dr. William B. Herms, head division of entomology and parasitology, University of California; Dr. L. O. Howard, chief, Bureau of Entomology, U. S. Department of Agriculture; Dr. Claude S. Hudson, consulting chemist, Bureau of Standards, Washington, D. C.; B. J. Hulse, Chamber of Commerce, Los Angeles, California; Dr. J. B. Johnston, dean, College of Science, University of Minnesota; Dr. David Starr Jordan, representing Stanford University; Eric Jordan, Stanford University; Dr. Charles L. Marlatt, chairman Federal Horticultural Board, Washington, D. C.; Dr. Francisco Maguel, Mexico City, representing the Republic of Mexico; Dr. E. D. Merrill, dean, College of Agriculture, University of California, representing Philippine government; Dr. Shirley P. Miller, department of anatomy, University of Minnesota; Dr. Frederick C. Newcombe, emeritus professor of botany, University of Michigan; Dr. Herbert Osborn, research professor of zoology, Ohio State University, Columbus, Ohio; Hon. W. H. H. Piatt, Kansas City, representing American Bar Association; Dr. James B. Pollock, associate professor of botany, University of Michigan; Roy R. Reppert, entomologist, Extension Service, Texas; Dr. Hiram Newton Savage, civil engineer, Berkeley, California; Dr. William A. Setchell, professor of botany, University of California; Professor Josephine E. Tilden, professor of botany, University of Minnesota, and head of the University of Minnesota Pacific Expedition; Dr. Koliang Yih, Chinese consul general, San Francisco, and Ralph N. Van Zwaluwenburg, United Sugar Company, Los Machis, Sinaloa, Mexico.

Dr. L. O. Howard, chief of the Bureau of Entomology, Washington, D. C., was permanent chairman of the conference; Dr. Charles L. Marlatt, chairman of the section on plant quarantine, plant entomology and plant pathology; Dr. Hamilton P. Agee, director of the Hawaiian Sugar Planters' Experiment Station, chairman of the section on sugar industry; Dr. L. A. Henke, professor of agriculture, University of Hawaii, chairman section on animal husbandry; Dr. P. J. S. Cramer, director experiment station, department of agriculture, Netherlands East Indies, chairman section on crop production and improvement;

Dr. Carl L. Alsberg, director Food Research Institute, Stanford University, chairman section on food transportation and distribution; Dr. R. Masujima, member of the Japan Bar Association, chairman section on international law and agreement, and Dr. Barton Warren Evermann, chairman of the section on fisheries, marine biology and oceanography.

Honorable Wallace R. Farrington, governor of Hawaii and president of the Pan-Pacific Union, speaking from the throne in Iolani Palace, welcomed the delegates, and Dr. Howard made the response.

All the general sessions were held in the Throne Room, Iolani Palace, in the forenoons, while the afternoons were given over to section meetings.

The conference was divided into several sections, among which some of the more important were those on sugar industry; fisheries, marine biology and oceanography; plant quarantine; plant entomology and plant pathology; animal husbandry; food-crop production and improvement; forestry in relation to agriculture; food transportation and distribution; and international law and agreements.

The problems considered by the conference were the big problems of food production, proper utilization and conservation, and they were considered in a broad way; the international viewpoint was constantly to the fore and the problems were discussed in their international relations. Basic principles relating to soil management, crop production, animal husbandry, the fisheries, care of crop products, transportation and distribution, insect-pest control, quarantine, etc., were presented and discussed in their world application, rather than those of merely local interest.

It is not difficult to see that a conference of nearly 150 representative men, experts in their various lines, gathered together from so many different countries, discussing before formal meetings and in informal meetings daily for a period of two weeks, these big food problems, could not fail to contribute greatly to our knowledge of these problems and to an understanding of the methods for their solution.

The meetings were intensely interesting from the very beginning to the last. Every delegate regarded the conference as one dealing with problems of world importance and demanding the most serious thought and treatment. That much good will come from the conference is certain.

The most important conclusions and agreements reached by the conference are set forth in a series of 33 resolutions adopted. Only a few may be mentioned: One calling for an international treaty for the protection and conservation of the fishery resources of the Pacific, particularly fur seals, sea otters, whales and other marine mammals; another for the protection of marine turtles; another to prevent pollution of the sea and coastal waters by oil tankers and other vessels, and a fourth recommending the formation of an international commission for the study of the physics, chemistry and biology of the North Pacific.

Other resolutions were adopted urging cooperative study of the insect pests of sugar cane, the problems of soil management and crop production, adoption of uniform and proper quarantine regulations and the appointment of an international crop protection board.

An account of the Food Conservation Conference would not be complete without mention of Alexander Hume Ford, the organizer and director of the Pan-Pacific Union. A few years ago Mr. Ford went from the States to Honolulu, as a newspaper man and writer. Soon after arriving at the "Cross-roads of the Pacific" he began to grasp the momentous importance of the problems of the Pacific. He conceived the idea that those problems could be solved only through an understanding of their scientific and commercial relations to *all* the countries bordering on the Pacific, and mutual understanding of the people of those countries. Mutual understandings among nations, as among individuals, are difficult if not impossible unless they know each other. Mr. Ford believed that, if the countries bordering on the Pacific could come to know each other, their international disputes and misunderstandings would largely disappear. So he organized all those countries into the Pan-Pacific Union, which at once began to hold conferences or congresses of various kinds. Any group of men who wish to get together to discuss important problems relating to the Pacific area, by making their wishes known to the Pan-Pacific Union, can have a conference called, and the Union will help by inviting delegates as requested, by arranging the details of the meeting, raising money to defray expenses and in any other proper way.

Several such conferences have already been held, including a scientific conference, an educational conference, a newspaper conference, a commercial conference and a food conservation conference.

The Pan-Pacific Union is probably the greatest force in the world to-day in promoting mutual understanding and good will among the countries of the Pacific area.

And Alexander Hume Ford has been the promoter, the moving spirit, the money-getter, the live wire, the man of vision, in all these conferences.

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THE FAILURE OF THE PRINCIPLE OF PRIORITY TO SECURE UNIFORMITY AND STABILITY IN BOTANICAL NOMENCLATURE

The priority of publication principle was adopted with the idea that it would furnish a simple and satisfactory basis for determining which of the various

synonyms that have been applied to most species should be used as a permanent binomial for each species, and at the same time give due credit to the author who first described and named the plant.

The great protagonist of the priority principle, Alphonse de Candolle, began to advocate and apply this rule about 75 years ago, and in 1867 it was adopted by the International Botanical Congress at Paris and has been, with some slight reservations, a part of all subsequent botanical codes.

All human activities, scientific and otherwise, are in the nature of experiments. After having carried on an experiment for a considerable period, it would seem desirable to summarize and evaluate the results obtained. It therefore may be worth while to note the results of 57 years of effort in the application of the principle of priority as a means of securing uniformity and stability in the use of plant names.

It may be appropriate to state briefly what should be reasonably expected from the application of the priority principle and why it has failed. A satisfactory plan should secure for us generic and specific names for plants which would be uniform throughout the world and stable; that is, the same name would always be applied to the same plant and this name would not be subject to change. It is very evident that this end has not been attained in any general way. There are various reasons why these efforts have not been successful and why there is little hope of success according to this plan.

If we examine and compare recent floras of different parts of the world or of different countries, it will easily be seen how far we still are from the desired end, even among the flowering plants where the principle has been applied longest and where the difficulties are least.

The fact that taxonomists after so many efforts have failed to come to any general agreement in regard to a code and that the adherents to different codes do not arrive at the same results in the application of their own rules appears to be rather strong evidence that something is wrong.

Fortunately or unfortunately, according to your point of view, the day of imperial edicts is about past and though organizations of scientists may pass "laws" or make rules they have no power to enforce them other than an appeal to reason and persuasion. The original Paris code recognized this fact when it stated that "rules should be so plain and so convincing that every one would be disposed to accept them." Many botanists and users of Latin names of plants have never been sufficiently convinced of the reasonableness or practicability of the various codes to approve and adopt the changes required, and if they should do so it would not give stability to the names, for continual changes would be necessary as older names were discovered, and thus much valuable time would have to be wasted in learning new names which should be spent in increasing our knowledge of the plants themselves. In mycology, for example, it would require a totally different application or rejection of many of our most common, best known and well-established names.

A few examples may be cited to show the sort of changes which would be required on a basis of priority of publication to the fungi. Hysterium, now applied to a large and well-known group, would be applied to the small genus of Discomycetes, now called Clithris. The name Valsa, instead of being applied to the present large group of species, would supplant the present name Xylaria. The familiar name Daldinia would be displaced by Perisphaeria and the name Phoma,[1] instead of being applied to the small pycnidial forms, as at present, would supplant the name Hypospila for a small group of Pyrenomycetes. The well-known generic name Hypocrea would become Corynesphaera. These are only a few samples of the new applications and the strange names which would have to be learned and used according to this rule as interpreted under the American code. Under the Vienna-Brussels code, with its various dates as starting points for different groups of fungi, the results would be very different and would vary according to the person applying them and his interpretation of the rules. Such names, after all, in the present state of our knowledge would only be "pro tem," as older ones might be found at any time or different interpretations of their application made by later taxonomists.

The principle of priority was supposed to have the particular merit of being easy of application and of producing uniform results. Experience has shown the fallacy of this idea. In applying the rule one immediately becomes involved in questions regarding the actual dates of publication of various books and periodicals and also with questions of validity of publication, and many others which continually arise. These practical difficulties have made it necessary to extend and modify the codes until they have become so long and complicated that our English friends say,[2] "The average botanist who is not an expert in nomenclature finds it difficult to interpret them correctly." They then go on to cite cases in which even the experts fail to agree. On account of these and similar

[1] Shear, C. L., "Phoma: A sample of mycological nomenclature and classification." *Mycologia* 15: 174–182, Jy. 1923.

[2] Britten, James, Ramsbottom J., Sprague, T. A., Wakefield, E. M., Wilmott, A. J. Sub-committee on nomenclature. Imperial botanical conference. Interim report on nomenclature. *Journ. Bot.*, 62: 79–81. March, 1924.

difficulties the zoologists have found it necessary to appoint a committee of experts to decide differences of opinion among the taxonomists as to the application of their rules and the choice of names to be adopted.

There is still no general agreement as to the date to be taken as a starting point in determining priority for the lower plants. There is also no general agreement as to what authors and publications shall be recognized nor exactly what constitutes valid publication. Of course when it comes to questions of synonymy there always will be more or less difference of opinion among specialists, and this can not be entirely avoided.

It is generally understood that the chief purpose of botanical names is to make it possible for all who use binomial names for plants throughout the world to designate particular genera and species conveniently and accurately and in as uniform a manner as possible. It should be recognized clearly that botanical names are no longer primarily for the specialist in taxonomy or the purely systematic botanist. There are large and increasing numbers of horticulturists, pathologists, general botanists and many specialists in plant research who find it necessary to use technical names of flowering plants and fungi. For all such users of plant names, the requirements are primarily practical and utilitarian. They can not be expected to continue to discard names which have been in use for a long time and which to them have a very definite application.

The idea that we are obligated to restore old names as a matter of justice to the early botanists is rather sentimental than ethical. Whatever is best for the benefit and progress of science and humanity is the primary consideration. To perpetuate an author's mistakes and failures, as is frequently the case in taking up old names, is no credit to the author and chiefly a source of trouble to us. The substitution of an obsolete generic or specific name for one in general use, unless for some more important reason than mere priority of publication, serves no sufficiently useful purpose to justify the inconvenience and trouble caused by the change.

The proposal to abandon the resurrection of obsolete names does not mean that we should neglect the history of mycology or the determination of synonyms, but that the current use and application of names should not depend upon such investigations, any more than that our present English vocabulary should be changed on account of the discoveries of philologists and the many obsolete words substituted for those now in common use. Philology is an interesting and valuable study, but no one has seriously attempted to change current usage of English on account of the older synonyms discovered.

A knowledge of the origin and history of binomials and their application and synonymy is interesting and important from an historical standpoint, showing the stages and modes of development of our knowledge of plants and their relationships and modes of treatment, as well as the development and workings of the minds of the various taxonomists. There seems to be no good reason, however, why we should keep changing the names of our common plants in order to reflect increases in our knowledge of the history of taxonomy and nomenclature and the synonymy of plant names.

So far as mycology is concerned the stupendous amount of labor involved and the insurmountable difficulties to be overcome make it impracticable and frequently impossible to determine with certainty the application of the vast number of fungus names to be found in systematic mycology and unless mycologists become more numerous and devote much more attention to the determination of the old species, it will be centuries before we can hope to have the last word said regarding the synonymy of the fungi and the oldest name located and adopted.

It is seen then that one of the principal reasons why stability of fungus names can not be attained for centuries at least, even though perfect agreement should be reached in regard to carrying out the plan, is the practical difficulty of labor, skill and time involved in determining the exact identity and synonymy of the vast number of names of genera and species which have been proposed; many of which have been very imperfectly described and have not been represented by any type or authentic specimens upon which satisfactory identifications can be based.

In the case of the fungi also the difficulties in determining with any reasonable degree of certainty just what organisms the older and also many of the more recent mycologists had before them when they prepared their original descriptions are so great as to be practically impossible in a great number of instances. Still there is usually somebody who will hazard a guess and attempt a change of names on that basis.

Since the writer has been personally interested in nomenclatorial questions for the past thirty years his present position and the reasons therefor may perhaps be worth stating. After much study and many attempts to apply the priority principle to the nomenclature of the fungi, we have finally been driven to the conclusion that even with the general adoption of various improvements, especially the type method of fixing the application of names, it will still be impossible to secure a reasonably uniform or stable nomenclature on that basis.

Until recently we have labored under the delusion that by access to the herbaria of the old mycologists and a study of their type specimens most of the questions of specific identity could be settled. Consider-

able experience, however, in the study of the older collections as well as those of recent mycologists in all the large herbaria in Europe and America has convinced me that in a great number of cases no certain determination can be made as to what particular plant the authors originally applied their names. Most of the old species are not represented by types in the true sense of the term, that is, in most cases it is impossible to say that any particular specimen, which may be in an author's herbarium or may have been labelled by him, is the particular one upon which he based his original description. Where such specimens do occur they are frequently too fragmentary or too poor for certain identification, and the time and labor consumed in attempting to find the type and determine it is in most cases not justified by the results to be obtained. The present application of many of the older names is based on tradition handed down from one mycologist to another.

If we are not to have stable names for our fungi until the possibility of finding older synonyms has been exhausted there will be a more or less continuous change of names for several hundred years to come, even though a considerably increased number of systematic mycologists undertake the work. Synonymy is important and should eventually be determined so far as practicable, but there is no justification for expending the time and energy required in discarding old names and learning new ones every time older synonyms are unearthed.

These considerations, taken in connection with the fact that there will always be, as now, more or less difference of opinion among mycologists as to the identity and validity of many of the older species, as may be used to determine, in case of synonyms, which shall be permanently adopted. It will no doubt be asserted that usage is too uncertain and indefinite to be practicable. We believe, however, that it can be placed upon a practical working basis and thus relieve us of the necessity of the more or less continuous change of names required by the priority rule.

Of course there is nothing new in this proposition. We simply wish to urge that it be recognized as a valid method of fixing plant names whenever possible and practical provision made for its adoption and application. The list of "Nomena Conservanda" adopted by the Botanical Congress at Vienna in 1905 was a partial abandonment of the priority rule and a recognition of the desirability, if not necessity, of accepting usage in some cases. Unfortunately, however, some of the names in that list were chosen from the standpoint of national or personal rather than general usage. Usage should be interpreted and adopted on an international basis.

A practical and, I believe, satisfactory method of carrying out the plan would be to have an international commission of expert taxonomists in different groups of plants prepare a list of the genera and species which should, on the basis of general usage, as found in the chief systematic literature, be adopted. For this purpose only works in the English, French, German and Latin languages would need to be consulted.

In order to assure certainty and stability in the use of the names adopted under any plan, a type species must be assigned for each genus and type specimens cited for each species.

Perhaps the most convincing proof of the failure of the priority principle to meet the requirements of the people who have most use for binomials is the fact that the principal users of flowering plant names, horticulturists, florists, nurserymen and others, have recently prepared and adopted a list of "standardized plant names."[3] A glance at many of the binomials adopted will indicate that they were not chosen because of priority of publication. The primary purpose of the list is said to be convenience and stability in the use of names in the horticultural trades. To accomplish this purpose a name for each plant has been more or less arbitrarily selected. While it is not specifically stated that general usage has played an important part in the choice of the names, the list shows many remarkable coincidences in this respect.

If these names are to be adopted by all practical and professional horticulturists, florists, nurserymen and pharmacists, as is indicated by the endorsement of their national organizations, the professional taxonomists will find little use for any new or old names which they attempt to substitute or reinstate for those in this list. Why not, then, frankly recognize the inevitableness of the situation and adopt these names and also proceed to complete the list for all wild as well as cultivated plants, and at the same time try to persuade other nations to do likewise.

There is one thing still necessary to make this list or any other meet the needs of scientific taxonomy as well as practical horticulture. That is, the designation of a particular species as the type of each genus and a specimen or specimens as type of each species and variety, in order that any doubt or question which may arise regarding the exact application of the names may be settled by comparison and study of typical specimens of the plants themselves.

Since the chief users of flowering plant names have found it necessary to abandon the priority principle and arbitrarily adopt names, how can mycologists and pathologists ever hope for uniformity and stability of the names of fungi on that basis? The difficulties in the way of determining with certainty the

[3] "Standardized Plant Names." A catalogue of approved scientific and common names of plants in American Commerce. American Joint Committee of Horticultural Nomenclature, pp. 1–546, Salem, Mass., 1923.

identity and synonymy of the nearly one hundred thousand so-called species of fungi in mycological literature are insuperable, as has been found by actual experience in studying a few genera, even with all the library and herbarium facilities of America and Europe available.

In order to facilitate the preparation of a list on a basis of usage it may be found desirable to omit from consideration under this plan names of less than 25 years standing, as such names could not perhaps in most cases be regarded as established by usage. As there is considerable dissatisfaction with present codes and their operation even among their adherents—as is evidenced by recent proposals in America and also by the report of the English committee cited—we hope careful consideration may be given to the usage plan.

This plan has the great merit of relieving us of the necessity of abandoning many of the names with which we have long been familiar and learning new and strange names in their place. This is a matter of great practical importance with most users of plant names and has been the source of much of their opposition to the various efforts to reform nomenclature. A well-prepared plan of this kind would probably receive the approval of the majority of botanists who are not particularly interested in taxonomy but still need to use plant names.

The selection of names for all plants on the basis of usage involves no difficulties other than those already overcome by the committee which prepared the list of standardized names mentioned. The zoologists have found it necessary to establish a commission to decide mooted questions regarding the choice of names under their code which is founded on the principle of priority, and a commission of expert plant taxonomists should find no greater difficulties in determining the choice of plant names on the basis of current usage.

As an example of the result of following usage as compared with priority among the fungi we may cite the genus Daldinia, a common and conspicuous Pyrenomycete. This generic name was applied by Cesati and de Notaris in 1863, and two species included *D. concentrica* and *D. vernicosa*. These are regarded as forms of one species by some mycologists. Fortunately, the priority rule has not yet been applied to the majority of fungus names and the name Daldinia has been generally used for these plants by the mycologists of the world ever since it was proposed. However, there are already known three other generic names which had previously been applied to this species. Perisphaeria, Roussel, 1808, and Peripherostoma, S. F. Gray, 1821, are typonyms, being based upon the same species as Daldinia. The third, Stromatosphaeria, Greville, 1824, included 19 species of which the first was *S. concentrica* and would therefore, according to the first species method, be taken as the type of the genus. What we propose is to accept Daldinia as the only valid name for this genus with the type species, *D. concentrica* Bolt., fixed and unchangeable. As to the specific name, *concentrica,* applied by Bolton in 1791, three other specific names of the fungus are already known which may claim priority of publication. These are *atrum* (*Lycoperdon atrum* Schaeffer, 1770), *tuberosa* (*Valsa tuberosa* Scopoli, 1772) and *tunicata* (*Sphaeria tunicata* Tode, 1791). On the priority basis the specific name would be *atrum.* We propose, however, to adopt the name *concentrica* because of general usage. As no original specimen of Bolton is known, a type specimen should be arbitrarily chosen. Cesati and de Notaris cite several specimens in connection with their description of the genus and the first of these might very properly be regarded as type of the species for future purposes. The specimen cited is Erb. Critt. Ital., No. 642. This set of exsiccati is found in the principal large herbaria, and typical specimens are therefore much more accessible to mycologists than the types of most authors.

As a reconsideration and modification of botanical codes is under discussion now, we would suggest that a more general and distinct recognition of usage be provided for in any revision that may be made.

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THE QUANTUM PUZZLE AND TIME

THE essential feature of the quantum theory is the postulate which restricts any periodic motion of an atom or molecule to a discrete series of allowed states of motion with wide gaps between which are not allowed. Stated in ordinary mechanical terms the quantum postulate may be exemplified as follows:

(1) *Simple to and fro vibration*: Consider a material particle of mass m, bound by a spring, and oscillating to and fro so that its distance q from its equilibrium position is

$$q = A \sin \omega t \qquad \text{(i)}$$

where A and ω are constants and t is elapsed time. Let p be the momentum ($= m\frac{dq}{dt}$) of the particle. Then

$$p = \omega m A \cos \omega t \qquad \text{(ii)}$$

and if we eliminate t from (i) and (ii) we get

$$\frac{A^2}{q^2} + \frac{p^2}{\omega^2 m^2 A^2} = 1 \qquad \text{(iii)}$$

This is the equation of an ellipse (if p and q are thought of as rectangular coordinates). The area of this ellipse is

$$\int p.dq = \pi\omega m A^2,$$

and because $p.dq$ is a quantity of the same nature as Planck's constant h the idea has arisen that the area of the pq-ellipse might be equal in general to an integral multiple of Planck's constant, or

$$\pi\omega m A^2 = nh \qquad \text{(iv)}$$

where n is an integer. This equation expresses Bohr's quantum postulate as applied to simple to and fro vibration, and the reader must not expect to know the "why" of this postulate, because no one knows the "why" of it. We deliberately and arbitrarily put $\pi\omega m A^2$ equal to nh, that is all there is to it—except results of the most remarkable kind; and when we put $\pi\omega m A^2$ equal to nh we are said to *quantize* the motion.

Solving equation for A we get

$$A = \sqrt{n}\ \sqrt{h/\pi\omega m} \qquad \text{(v)}$$

and the restriction which equation (iv) places on the simple to and fro motion of equation (i) is that the amplitude A of the motion can not have any value whatever but only a discrete series of values which are proportional to the square roots of the successive integers $n = 1, 2, 3, 4$, etc. This conclusion is absurd from the ordinary mechanical point of view because it means, for example, that a pendulum bob can not oscillate with any amplitude whatever but only with amplitudes which form a discrete series as expressed by equation (v).

(2) *Simple rotation*: When applied to simple rotation Bohr's postulate restricts the speed of rotation of a given body to a discrete series of speeds for which the angular momentum of the rotating body is an integral multiple of $h/2\pi$, which means that the only possible speeds in revolutions per second are those which are integral multiples of $h/4\pi^2K$, where K is the moment of inertia of the body.

This conclusion is absurd from the ordinary mechanical point of view because it means, for example, that a grindstone can not have any speed whatever, but that all possible speeds must constitute a discrete series so that if a grindstone were speeded up it would have to increase its speed by sudden jumps!

These sudden jumps in speed evidently mean discontinuity; and, in general, Bohr's postulate means discontinuity of time or discontinuity of space, or both. It seems strange, therefore, that we should take Bohr's postulate seriously, considering that the postulate is merely a "happy thought" of Bohr's which nobody understands (Bohr himself does not pretend to understand it) and considering that the postulate leads to results which are absurd from the ordinary mechanical point of view. We do take Bohr's postulate seriously, however, because it has led to a theory of line spectra which is in extremely exact agreement with nearly all the known facts of spectrum analysis, to say nothing of several other highly important applications of the Bohr and Planck quantum postulates. On the other hand, the apparent absurdity of the Bohr postulate from the ordinary mechanical point of view can not be demonstrated experimentally, that is to say, the discrete series of allowed states of motion of a pendulum, for example, are so extremely close together that the discrete series is indistinguishable experimentally from a continuous series.

We do an injustice to the remarkable ingenuity of Bohr when we speak of his postulate as a mere "happy thought." It would be much nearer the truth to say that Planck was constrained to his original quantum postulate by a keen appreciation of the experimental facts of heat radiation and that Bohr was constrained to his quantum postulate by his keen appreciation of the experimental facts concerning line spectra. The quantum postulates (Planck's and Bohr's) are perhaps the most ingenious contrivances ever evolved from the contemplation of experimental facts in physics.

It is not the purpose of this note to set forth even the simpler aspects of Bohr's quantum theory of line spectra but rather to point out that our notion or intuition of time seems to become meaningless in connection with quantized motion.

It is to be noted that the time t is at least formally eliminated from equations (i) and (ii) to give equation (iii), and to describe the state of a simple oscillator on the basis of equation (iii) is to make use of the momentum p as a basic idea instead of time. Similarly, angular momentum becomes basic in the quantum-theory description of the state of a simple rotor. Of course momentum, as ordinarily thought of, involves the idea of velocity and therefore also the idea of time; but if we postulate momentum as a basic idea and if we could refrain from "thinking" of the state of an oscillator or rotor as "motion" we would have time-free descriptions of the states of an oscillator or rotor. This statement should call to the reader's mind the central paradox of Bohr's theory, namely, that although the Bohr states of the hydrogen atom are described as orbital motions when we wish to *think* about these states, yet such descriptions seem to be essentially artificial, and the motion, as we think of it, really non-existent. The difficulty is that time is to us an essential mode of thought, whereas there is no actual physical condition or thing bound up in a Bohr state which corresponds to time as a fact. This is, of course, a dilemma; any resolution of this dilemma, however consistent and logical, will be necessarily unthinkable; and, before proceeding to discuss an unthinkable resolution of this dilemma, let me paraphrase a statement of Bohr's.

We are not at all justified in assuming that our human ways of thinking about things we see and handle are

suitable ways of thinking of atomic action. Our human ways of thinking are bound up inextricably with our intuitions of space and time, and atomic action may not take place in what we call space and time.

This is the dilemma.

What fact or condition in nature is it that comes nearest to our intuition of time? or is most closely in accord with our feeling of an inevitable forward movement which we call time? What fact or condition in nature is it that most certainly justifies our idea that something or other in general in this world of ours always does go forward and never does nor ever can go backwards? What observed condition or thing is it that embodies as a fact the essential quality of intuitive time? The answer, as it seems to me, is evident. It is what in thermodynamics we call the irreversibility of natural processes. This condition or fact underlies the second law of thermodynamics, and the law of increase of entropy is the most completely non-anthropomorphic generalization that grows out of it. The law of increase of entropy and our intuition of time unquestionably grow out of the same condition in nature, but entropy and time as physical quantities differ[1] from each other very greatly because of our artificial methods of measuring them.

Imagine a purely mechanical system, a system not involving any irreversible action. After sufficient "time" such a system will certainly come back to its initial condition, and everything will be as at first; except that "time" has elapsed. What does this mean? Where has "time" elapsed? What is this elapsed "time" which makes a difference between the initial and final states of our system which initial and final states are exactly alike? The difficulty is that someone is supposed to look at or contemplate our supposed purely mechanical system. This someone is certainly not a purely mechanical thing, and therefore the totality of things under consideration is not purely mechanical in the sense of being entirely free from irreversible action. The moment you look at or contemplate a perfectly mechanical system the time idea or the time intuition becomes essential and real.

However, if time is an objective condition and if it is bound up with thermodynamic irreversibility it can not have a universal and uniform forward flow, it must go forwards irregularly and unequally as resident in different things, and it can not go forwards at all as resident in a purely mechanical thing.

[1] The simplest argument which leads to the notion of entropy makes increase of entropy proportional to lapse of time. See Nichols and Franklin's "Elements of Physics," Vol. II (1894), or see Franklin and MacNutt's "Heat" (1924), pp. 128–140.

A purely mechanical world would certainly be timeless. The introduction of a mere observer would introduce time as a fact, this fact-time would be wholly bound up in the observer as a non-mechanical thing, and this fact-time would be irregular if the observer is of the ordinary sleeping and waking kind! Furthermore, the introduction of a thinker would introduce time as a uniform forward blow, time as an intuition, time as a mode of thought.

About all we can say of the steady states of the hydrogen atom as conceived by Bohr is that they are *steady states,* states which involve no irreversible action, no absorption or emission of radiation, no change of any kind. Now a purely mechanical system is an unrealizable ideal because radiation exists everywhere and no mechanical system can be so isolated as to be free from irreversible action. But a hydrogen atom in a steady state is immune to radiation and probably immune to electron bombardment when certain threshold conditions are not over passed so that a hydrogen system in a steady state is perhaps entirely free from irreversible action, a kind of supermechanical system, as it were. The idea of lapse of time would therefore seem to be an absurdity when applied to a hydrogen atom in a steady state, although we must necessarily make use of the idea of time in describing a Bohr steady state as "motion."

In the Bohr theory the atom is supposed to jump from one quantized state to another of lesser energy, and the energy lost is supposed to be radiated in accordance with Planck's postulate which is that

$$h\nu = \Delta W \qquad \text{(v)}$$

where h is Planck's constant, ΔW is the energy lost by the atom, and ν is the frequency of the emitted radiation. But what happens "while" the jump is taking place, if time does not go forwards at all during a steady state, and does go forwards discontinuously or with a jump "during" the transition from state to state? This is the kind of attempt at thinking that one is repeatedly making in considering the Bohr theory which seems really to demand the non-existence of time!

Non-existence of time; suppose such to be the case. But the emitted radiation has a definite measurable wave-length or frequency, and, surely, a frequency necessarily involves time! This is the way we think of a frequency, to be sure, and two things may be said in criticism of the way in which we think of such a thing; but before saying these things let me suggest (and I admit that my suggestion is extremely vague) that the time element which enters to fix the frequency of the emitted radiation may be bound up with an entropy change which is associated with the transition of the atom from state to state. The Bohr jumps are now thought to be reversible because radia-

tion seems sometimes to be absorbed by an atom and cause a jump to perform itself backwards; but I certainly believe that some essential element of irreversibility must eventually be discovered in atomic action, because the older kinetic theory as developed statistically leaves irreversibility essentially unexplained.

Where is the fallacy of the time-idea in our notion of frequency? Look at a swinging pendulum and count its movements in a measured time. This you can do, and you thus find the frequency. Similarly, let me ask you to look at a hydrogen atom in a steady state and count the number of revolutions of the electron in a measured time. This sounds logical enough, but the atom in a steady state does not radiate, and there may be a fundamental fallacy in even imagining that one might look at such an atom. As we see things, so we think of them, and our see-thinking may be absurd when carried over to things which are essentially un-seeable; essentially un-seeable, mind you, not merely too small to see.

Or suppose you look at the "kinks" (waves?) of the emitted radiation as they come out of an atom when it jumps from Bohr state to Bohr state and count the number of kinks in a measured time. This also sounds logical enough, but after the jump the atom is in a steady state and no time elapses in the atom, and once a radiation is established the radiation is itself a steady state and no lapse of time can reside in the radiation. The idea of frequency would seem to be applicable to radiation only when the radiation has stretched out in our large-scale world and has come into relation with large-scale things where time is a legitimate idea. Our intuitive notion of time, as it seems to me, is tenable only in large-scale physics, or macro-physics, but untenable in small-scale physics, or micro-physics.

My suggestion that time does not exist in a purely mechanical system refers only to what we think of as continuous time or time flow, it is not intended to deny the reality of coincidences in time.

All, or nearly all, of our time and space experience grows out of coincidences in time and coincidences in space. Even the measurement of a length depends wholly on coincidence observations. A yard stick is fitted to the successive parts of the distance to be measured and each such "congruence operation" involves two coincidence observations, one at each end of the yard stick. The measurement of a time interval also consists almost wholly of coincidence observations. Furthermore, the vast complex of everyday life in its sense aspects involves little else than coincidence observations. But even men of the street are accustomed to express time and space experiences in terms of quantitative ideas, and this purely mental habit has come about, no doubt, because to express these experiences in purely experimental terms would be extremely tedious. Our quantitative notion of time as a continuum of duration and our quantitative notion of space as a continuum of extension come wholly, it would seem, from our mathematical predilections. No one, as it seems to me, could maintain that these quantitative notions of space and time are essential in the most complete sense-orientation of a man in any situation in life; but it would be impracticably and even unintelligibly tedious to talk about space and time experiences without using quantitative ideas. Herein lies the reason why any point of view which is contrary to our ideas of continuous space and continuous time is unwelcome. Our mathematical bias, note that I now use a stronger word than predilection, is wholly in favor of continuous mathematics and wholly opposed to discontinuous mathematics, and the reason of this bias is evident to those who have attempted to develop a discrete or discontinuous mathematics!

I am convinced that the qualifications of our ordinary notion of time which I have suggested[2] contain nothing whatever that is inconsistent with experience, and, however absurd these qualifications may seem to be, it must be admitted, as it seems to me, that the quantum puzzle becomes more clearly defined as a puzzle in terms of these qualifications.

If the Planck and Bohr postulates contain some new thing that is essential for the description of atomic action, and no one who is familiar with the amazing developments that have been made on the basis of these postulates can doubt that they do contain something new which is essential, then we must expect soon to see a more wonderful transformation of our conceptions of the physical world, a vastly more wonderful transformation, than that which has resulted from the relativity theory.

Wm. S. Franklin
Massachusetts Institute of Technology

SCIENTIFIC EVENTS

EXHIBIT OF THE ROYAL SOCIETY AT THE BRITISH EMPIRE EXPOSITION[1]

One of the most fascinating and impressive sections of the British Empire Exhibition, though admittedly one that is essentially specialist, is the exhibition of pure science arranged by the Royal Society. In connection therewith the Royal Society has now issued a handbook which is a great deal more than a mere catalogue, and is, indeed, a volume which might well be secured by students of pure science and amateurs,

2 This suggestion was first made in a paper on "Entropy and time" in the *Physical Review*, Vol. XXX, pp. 766–775, June, 1910.

1 From the London *Times*.

and preserved by them as a text-book long after the exhibition has been closed.

As a foreword to the handbook shows, this exhibit was organized, at the request of the government and out of funds provided through the Department of Overseas Trade, by the Royal Society. The council of that body appointed a British Empire Exhibition Committee, under the chairmanship of Sir Richard Glazebrook, to carry out the task. In the majority of cases the exhibits are shown by the scientific men actually engaged in the work, supplemented by instruments lent by some of the leading firms of scientific instrument makers. Arrangements have been made, wherever possible, to demonstrate the use of the instruments and apparatus in the methods in which they have been employed by the authors whose work is illustrated. Demonstration benches, fitted with gas, water and electricity, are provided, and a staff of scientific assistants is in attendance. Owing to the limited space available it has been necessary to arrange for the rotation of certain of the exhibits, particularly those shown on the demonstration benches.

The handbook is arranged in two parts. The first is a series of articles by well-known authors, intended to give some indication of the state of science at the time of the opening of the exhibition, while the second is a descriptive catalogue. In certain cases the Royal Society has been instrumental in arranging exhibits which are shown in the scientific section of the chemical hall in the palace of industry. Descriptions of these exhibits are given in the catalogue, but the fact that they are shown elsewhere is indicated. The following is a list of the articles in the handbook, together with the names of the contributors:

"The genesis of the Royal Society," Dr. Irvine Masson; "The electron," Sir Joseph Thomson, O.M.; "X-rays and crystal structure," Sir William Bragg; "Electricity and matter," Sir Ernest Rutherford; "Atoms and isotopes," Dr. F. W. Aston; "Verification of the theory of relativity," Sir Frank Dyson; "The interior of a star," Professor A. S. Eddington; "The origins of wireless," Sir Richard Glazebrook; "Thermionic valves," Professor J. A. Fleming; "The origin of spectra," Professor H. Fowler; "Helium gas and its uses," Professor J. C. McLennan; "The principles of fine measurement," Dr. J. E. Sears; "The circulation of the atmosphere," Sir Napier Shaw; "The water in the atmosphere," Dr. G. C. Simpson; "Weather forecasting," Lieutenant-Colonel E. Gold; "Atmospheric electricity," Dr. C. Chree; "The origin of man," Dr. A. Smith Woodhead; "The circulation of the blood," Professor E. H. Starling; "The biological action of light," Professor D. T. Harris; "Muscular work," Professor A. V. Hill and Professor E. P. Cathcart; "Insect mimicry and the Darwinian theory of natural selection," Professor E. B. Poulton; and "The origin of the seed plants," Dr. D. H. Scott. Sir Richard Glazebrook (physics), Sir Napier Shaw (geophysics), and Mr. Tate Regan (zoology and botany) have written in the descriptive catalogue of exhibits.

FRENCH UNIVERSITY MISSION TO MOROCCO

With the purpose of stimulating interest in the French undertakings in Morocco and spreading a true knowledge of the country, the administration of the Protectorate arranged for a French University Mission to visit the country in October, 1923. According to the British *Journal of Geography* the mission was not confined solely to geographers, but numbered among its members geologists, jurists and historians. An entire number of *Annales de Géographie* (May 15, 1924) is given up to an account of the tour, and to articles both by members of the mission and by government officials. From October 9 to 26, a considerable area was covered, partly by motor, partly by varying local means of transport. Landing at Casablanca, the party visited Marrakesh, Rabat, Meknes and Fez, besides other places further from the beaten track, and reembarked at Oran. The first article in the *Annales,* by J. Célérier, gives a detailed account of the country traversed, with particular attention to the physical features and regions and the position of the towns: its geology is detailed separately by J. Savornin. Proofs of the desiccation of a portion of Morocco are advanced by E. de Martonne and others in the course of a morphological study of the Rehamna massif. Here the change in the hydrographic *régime* has been related to deforestation. The present condition of the vegetation of Morocco is detailed by M. Sorre, who, by constructing a provisional vegetation map, has shown its close relation to the rainfall, particularly in the coincidence of the "Mediterranean" area of the Atlantic coast with that of heavy rains. The native population of Morocco is analyzed by MM. A. Bernard and P. Moussard, who correct the impression that it may be divided upon a language basis into Arabs and Berbers, for a great part of the Arab-speaking people are racially Berbers. The distribution of the Berber-speaking population follows very closely the physical relief of the country. As would be expected, the Berbers inhabit the mountains, the Arabs the plateaux and plains, with intermediate bi-lingual areas. As to the French civil population, it appears from a note by G. Jacqueton on "La colonisation français au Maroc," that at present it numbers about 55,000. A census, taken in March, 1921, showed that of the total civil population of 49,000, 41,000 were living in the towns, notably Casablanca and Rabat. After deducting officials, artisans, and business men from the remainder, the number of agricultural colonists and their families would seem to be little more than 3,000. To improve this state

of affairs, the government have initiated a scheme under which, between 1918 and 1923, 449 lots, amounting altogether to 71,496 hectares, have been settled.

THE THIRD PAN-AMERICAN SCIENTIFIC CONGRESS

THE opening of the Third Pan-American Scientific Congress, which was due to take place November 16, has been postponed to December 20. The reason for the adjournment is that the congress, if it met in the second fortnight of November, would clash with a period of intense scholastic activity in the universities of Peru and other countries of America. The organization committee has therefore been led to request that the congress be postponed for a few weeks, and the Peruvian government has fixed December 20 as the date of the inauguration.

Desiring to obtain all possible benefits out of this circumstance, the organization committee has furthermore resolved that the period within which papers can be presented, which expired on October 1 of this year, be extended one month more; said papers may therefore be received up to November 1. As provided under the regulations of the congress, in case an author is unable to send in his work in time, he shall at least forward a summary thereof not exceeding 1,500 words. Such summary must be presented with each work, irrespective of the latter itself being sent in in time. The members of the organization committee are confident that this new adjournment of the opening of the congress will allow many American scholars greater latitude in the presentation of their studies and monographs for the congress.

The "Compania Peruana de Vapores" (Peruvian S. S. Co.), and the Grace Line have decided to allow a 25 per cent. reduction on its fares to members and adherents to the congress; the Peruvian Corporation has agreed to grant them a 50 per cent. rebate on its railway and Lake Titicaca steamboat fares. Negotiations are under way with other steamship companies for similar facilities.

JOSÉ J. BRAVO,
Secretary General

PROGRESS IN STANDARDIZATION

THE increasing interest and activity in industrial standardization is demonstrated by the new Year Book of the American Engineering Standards Committee. The work of the committee is indicative of the growth of the movement as a whole. One hundred and fifty-two projects have been completed, or are under way, and in these various projects two hundred and thirty-five national organizations, technical, industrial, governmental, are officially cooperating through accredited representatives. The number of the individuals serving under various sectional committees of the different projects is nearly 1,100.

Of the projects which have reached an official status, 31 have to do with civil engineering and the building trades; 25 with mechanical engineering; 15 with electrical engineering; four with automotive subjects; 11 with transport; one with ships and their machinery; 14 with ferrous metals; 15 with non-ferrous metals; 12 with chemical subjects; two with textiles; five with mining; five with the wood industry; one with the paper and pulp industry, and 11 projects with topics of a miscellaneous or general character.

Cooperation in joint activities between Mr. Hoover's division of simplified practice and the American Engineering Standards Committee has steadily increased. In general the work of the committee is concentrated upon standardization projects which involve technical considerations, while the division of simplified practice concentrates upon such eliminations as it is possible to carry out from a consideration of statistical production data alone, or as stated in the book on trade association activities issued by the Department of Commerce, "the layman can proceed successfully with a simplification program, while it would be impossible for him to consider seriously standardization problems by himself."

In order to meet the demands made upon it by industry, and to supply the needs of the various working technical standardization committees, the American Engineering Standards Committee has greatly broadened its information services, and has added an engineer translator to its staff for this purpose. In this way, complete information is made available to sustaining members, trade and technical associations and other inquirers on standardization activities in foreign countries, as well as in the United States.

A new development is the appointment of local representatives of the committee in four important industrial centers. These are: K. F. Treschow, secretary, Engineers Society of Western Pennsylvania, Pittsburgh; J. B. Babcock, executive secretary, Affiliated Societies of Boston; Edgar S. Nethercut, secretary, Western Society of Engineers, Chicago; Professor George S. Wilson, Engineering Experiment Station, University of Washington, Seattle.

One of the most striking developments of the standardization movement is the increasingly important rôle which trade associations are playing in it. More than 140 national trade associations are officially participating in standardization projects under the auspices of the American Engineering Standards Committee. That standardization is a legitimate and constructive activity for associations is everywhere recognized, and explicitly so by a recent decree of the U. S. District Court at Columbus, Ohio.

MEETING OF ELECTROCHEMISTS AT DETROIT

THE next meeting of the American Electrochemical Society will be held at the Hotel Tuller, Detroit,

Michigan, on October 2, 3 and 4. The subjects covered by the program have a wide commercial bearing.

Two sessions will be devoted to the subject of "Corrosion," a subject of interest not only to the electrochemist, but to engineers in every field of activity. Contributions to this subject have been received from all parts of the world and the sessions promise to be well attended.

Detroit is the heart of the automobile industry of this country, and it is very fitting for the society to have at this time an open forum on the topic "Industrial Electric Heating," in which field the automobile industry has made such remarkable strides. Professor C. F. Hirshfeld, of the Detroit Edison Company, is responsible for the program on electric heating. There will also be sessions on refractories for electric furnaces and the physical chemistry of electrodeposition.

Two round table discussions have been arranged, one on "Electric furnace cast iron," in charge of Mr. G. K. Elliott, of the Lunkenheimer Co., Cincinnati, and the other, on "Control methods in electrodeposition," in charge of Professor O. P. Watts, of the University of Wisconsin, and Dr. William Blum, of the Bureau of Standards.

Mr. Alex Dow will address members and guests on Friday evening, his subject being "Central station design and superpower."

Aside from the technical and scientific program, the entertainment committee has made adequate preparations. For Wednesday evening, a "Get-together" dinner at the Eastwood Inn has been arranged. Other entertainment features include a smoker at Hotel Tuller roof garden, automobile trips and a theater party for the ladies, and visits to a number of the large automobile plants.

SCIENTIFIC NOTES AND NEWS

PROFESSOR FREDERICK SODDY, professor of chemistry in the University of Oxford, has been elected a foreign member of the Accademia dei Lincei of Rome.

SIR FREDERICK MILLS, chairman of the Ebbw Vale Steel, Iron and Coal Co., has been elected president of the Iron and Steel Institute of England, to succeed Sir William Ellis, managing director of John Brown and Company, Sheffield; Professor H. le Chatelier, W. H. Hewlett, E. Steer and C. J. Bagley have been elected honorary vice-presidents and Sir Charles Wright, E. W. Harbord and W. R. Lysaght ordinary vice-presidents.

A BAS-RELIEF was unveiled at the Roscoff Biological Station, France, on August 10, in memory of Dr. Yves Delage, who was professor of zoology at Paris and for many years director of the Biological Station.

AT the sixth meeting at Luxembourg, from August 3 to 5, of the International Dental Federation, Dr. Truman W. Brophy, of Chicago, president of the federation, was awarded the Miller memorial prize for important work in connection with dentistry.

DR. J. A. PRESNO, editor of the *Revista de Medicina y Cirugía* of Havana, president of the Academy of Sciences, has been elected corresponding member of the Surgical Society of Paris. The French government has also decorated him as chevalier of the Legion of Honor.

THE council of the National Institute of Agricultural Botany at Cambridge, which is entrusted with the award of the medal struck to commemorate the services of the late Mr. John Snell to potato husbandry, has given the medal for 1923 to Professor H. M. Quanjer, of Wageningen, Holland, for his work on the virus diseases of potatoes.

THE Alvarenga prize has been conferred by the Academy of Sciences at Lisbon on Dr. Vasco Palmeirim for his monograph on "Shock."

DR. PAUL E. HOWE, associate in the department of animal pathology of the Rockefeller Institute at Princeton, N. J., has been appointed biological chemist in the animal husbandry division of the Bureau of Animal Industry, and will have charge of the nutrition investigations in animal husbandry.

F. J. CRIDER, professor of horticulture at the University of Arizona, has resigned to become director of the Boyce Thompson Southwestern Arboretum at Superior.

DR. E. W. WALCH, Dutch physician, who has been placed in charge of malaria control for the island of Java, is visiting the United States.

ERNST J. SCHREINER, from the New York State College of Forestry, Syracuse University, has been secured by the Oxford Paper Company for investigations with *Populus* in which The New York Botanical Garden is cooperating.

THE *Journal* of the American Medical Association states that it is proposed to celebrate the seventy-fifth birthday of Professor Ivan P. Pawlow, the physiologist, on September 21, by issuing a souvenir volume of the *Archives for Biological Sciences,* the official organ of the Institute for Experimental Medicine at Leningrad. The articles for the special number are to be published in the language of the writers. Professor Pawlow has declined any personal official ceremony.

DR. WILLIAM BOWIE, chief of the division of geodesy of the U. S. Coast and Geodetic Survey, and secretary of the American Geophysical Union, sailed from New York on September 9, on the *Roussillon,*

of the French line, for Spain. He will attend, as representative of the United States and of the Coast and Geodetic Survey, the conferences of the International Geodetic and Geophysical Union which will be held at Madrid, from September 24 to October 8. Dr. Bowie is president of the section of geodesy of the International Union.

DR. LOUIS A. BAUER, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, sailed from New York on September 13, in order to attend the meeting of the International Geodetic and Geophysical Union at Madrid. He expects to return to Washington on October 20.

DR. FRITZ HABER, of Germany, noted for his work on the fixation of nitrates from the air, who is now in the United States to give a lecture at the Franklin Institute Anniversary, will make an official visit to Japan, empowered by President Ebert to present a collection of German scientific books to replace those destroyed in the Imperial Library by the earthquake and fire.

PROFESSOR LUIGI LUGGI, of the University of Genoa, has sailed for New York to represent Italian institutions of learning at the coming celebration of the centenary of the founding of Rensselaer Polytechnic Institute, at Troy, N. Y.

THE Danish Arctic explorer, Lauge Kock, has left Copenhagen for the United States, to accept invitations to lecture before a number of American societies and universities.

DR. J. H. L. CUMPSTON, director-general of health of Australia, is visiting this country under the auspices of the International Health Board.

ROALD AMUNDSEN, Arctic explorer, has filed a voluntary petition of bankruptcy and has definitely cancelled his projected aerial trip to the North Pole.

DR. NELSON H. DARTON, of the United States Geological Survey, has arrived in Mexico City to begin the study of the Cuicuilco ruins in the vicinity of Tlapan, thirty miles from the city.

DR. A. B. STOUT, director of the laboratories of the New York Botanical Garden, spent two weeks during July and August at Presque Isle, Maine, continuing studies on sterilities of potatoes in cooperation with the U. S. Department of Agriculture.

DR. BARTON WARREN EVERMANN, director of the Museum and the Steinhart Aquarium of the California Academy of Sciences; Miss Alice Eastwood, curator of botany in the academy, and Dr. Mary Page Campbell, member of the academy, have returned to San Francisco from Honolulu where they were in attendance at the Pan-Pacific Food Conservation Conference from July 31 to August 14. All were delegates from the California Academy of Sciences, and Dr. Evermann was a delegate also from the Pacific Division of the American Association for the Advancement of Science and from the San Francisco Chamber of Commerce.

JOSEPH MAILLIARD, curator of birds and mammals in the California Academy of Sciences, accompanied by Mr. Jack Malloch as assistant, has gone to northeastern California to continue his studies of the birds and mammals of that region. They expect to remain in the field about two months. Special attention will be given to problems of local distribution.

E. P. VAN DUZEE, curator of entomology in the California Academy of Sciences, has returned from southern Arizona where he and his assistant, J. O. Martin, spent six weeks collecting Hemiptera and other insects. He brought back about 15,000 specimens to enrich the academy collections.

PROFESSOR W. OSTWALD, of the chair of colloid chemistry in relation to biology at the University of Leipzig, has been delivering a course of lectures at the Institute of Applied Chemistry at Barcelona.

PROFESSOR E. VITORIA, director of the Sarria Institute for Chemistry at Barcelona, has arrived in Argentina where he is to deliver a course of lectures at the Buenos Aires and La Plata Universities on chemistry and laboratory methods.

DR. HENRY KRAEMER, formerly professor of pharmacognosy and dean of the College of Pharmacy at the University of Michigan, has died, aged fifty-six years.

DR. GEORGE W. HUBBARD, founder and for forty years head of Meharry Medical College, Nashville, Tennessee, died on August 22.

THE death is announced of Geo. Baptista de Toni, professor of botany in the school of veterinary medicine of the University of Modena, at the age of sixty years. Dr. de Toni was elected a member of the Paris Academy of Sciences last June.

DURING the months of April and May the departments of botany and zoology of the University of the Philippines, Manila, held their first summer session at the temporary Marine Biological Station at Puerto Galera, Mindoro. Twenty-one students, most of them instructors of biology in various colleges and high schools, attended the courses either in botany or zoology under Dr. R. Kienholz or Dr. P. B. Sivickis, respectively.

ON August 29, eight students of zoology from the University of Pittsburgh returned from British Guiana where they had spent the summer months studying ecology under the direction of Professor Alfred Emerson. This was the first organized university

class ever held in the tropical rain-forest and was so successful that other classes will be sent from the University of Pittsburgh in future years. The students spent nearly their entire time at the Tropical Research Station of the New York Zoological Society at Kartabo, British Guiana.

After a four months' leave of absence engaged in investigations on Fanning and Washington Islands, Professor W. B. Herms has returned to active work in the department of entomology and parasitology of the University of California. While on Fanning and Washington Islands certain coconut pests were investigated, mainly the borer, *Diocalandra taitensis* (Guerin), which is responsible for considerable damage on these islands. In addition Professor Herms and his assistant, Mr. Harold Kirby, Jr., fellow in zoology, made a general study of the fauna and flora of both islands, particularly Fanning, which is a typical coral atoll and presents a fertile field for the biologist. Extensive collections of both plants and animals were made for later studies and deposit in the interested museums of the University of California.

The Goessmann Laboratory of Chemistry at the Massachusetts Agricultural College, in Amherst, will be dedicated on October 3. The speakers will be Dr. C. A. Browne, of the Bureau of Chemistry, U. S. D. A.; Dr. Thorne M. Carpenter, of the Nutrition Laboratory of the Carnegie Institution of Washington, in Cambridge, Mass.; Dr. Frederick Tuckerman, of Amherst, and Dr. J. B. Lindsey, head of the Department of Chemistry.

By the will of the late Mrs. Henrietta O. Littleton, the American Museum of Natural History receives $100,000.

The Adelaide correspondent of the London *Times* reports that the congress of the Australasian Association for the Advancement of Science opened on August 25. Large Australian and New Zealand delegations were present, and an important *agenda* occupied the week. Lieutenant-General Sir John Monash, who succeeded Sir George Knibbs, the director of the Institute of Science and Industry, delivered the presidential address on "Power development." He said that Australian investment in electrical transmission had been relatively negligible, and that much research should be done before committing themselves deeply to a more extensive use of present methods. Speaking at the mayor's reception, Sir George Knibbs said that it was well that Australia's spirit of appreciation for science had grown so rapidly, as it was essential to acquire sufficient wealth and population to meet all contingencies. Sir John Monash pleaded for a greater recognition of science by public men, and for larger state grants to scientific institutions.

According to the *Journal* of the American Medical Association, the incorporation of the Academy of Medicine of Cleveland has been completed and the secretary of state has issued a charter. The change necessitated the election of a board of directors or trustees by the members who shall hold office for a stated period of years. The new board of directors comprises Drs. Harold Feil, Samuel J. Webster, Edward P. Monaghan, L. Morris, Clyde L. Cummer, Jacob E. Tuckerman, Harold O. Ruh, Frederick J. Wood, Harry V. Paryzek, Lawrence A. Pomeroy, Arthur J. Skeel, Frank S. Gibson, John D. Osmond, Richard Dexter, Harry D. Piercy. The new officers are: president, Jacob E. Tuckerman; vice-president, Edward P. Monaghan; secretary-treasurer, H. V. Paryzek.

The first survey to be made by the proposed naval research expedition would be devoted to the Gulf of Mexico-Caribbean region under recommendations formulated on August 28, at a meeting of the executive committee of the interdepartmental conference on oceanography, held at the Navy Department. The tentative program lists as the next step "neighboring parts of the North Atlantic," then south through the Panama Canal into the Pacific to the Galapagos Islands. Subsequent work would be carried on in the waters of the North Pacific.

UNIVERSITY AND EDUCATIONAL NOTES

Ernest Gates, of Yorkshire, England, has promised to provide the sum necessary to complete the endowment of a School of Pathology for Cambridge University. The trustees of the Rockefeller Foundation recently offered the University of Cambridge to provide £100,000 to build a school of pathology, together with the sum of £33,000 towards its endowment, provided the university raised an additional £33,000.

The University of Paris has accepted a donation of five million francs from M. Biermans and Mme. Laporte for the construction of a dormitory for students from Belgium, Luxembourg and Limbourg.

W. C. Nichol, lieutenant-governor of British Columbia, has given $18,000 to the University of British Columbia to provide three scholarships of $1,200 each, tenable for five years at French universities, with the object of promoting a better understanding between the British and French races.

Dr. Marion Talbot, professor of household administration and dean of women at the University of Chicago, has given to the university $15,000 to be used as an endowment for the advancement of the education of women.

THE following promotions have been made at the University of Chicago: Dr. William Duncan MacMillan to professor of astronomy; Dr. Adolf C. Noé to associate professor of paleobotany, and Dr. Marion H. Loeb to assistant professor of anatomy.

DR. GEORGE R. BANCROFT, associate professor of physiological chemistry, has been promoted to the rank of full professor and head of the department of physiological chemistry in the School of Medicine of West Virginia University.

DR. FRANK E. RICE, assistant professor of chemistry at Cornell University, has been appointed professor of biochemistry at the North Carolina State College.

THE following additions to the staff of the department of physics of the University of Pittsburgh are announced: professor and head of the department, L. P. Sieg, of the University of Iowa; assistant professors, Richard Hamer, of the University of Wisconsin, and W. St. Peter, of the University of Michigan; instructors, Theodore Hunter, of the University of Iowa; M. H. Trytten, of Luther College, and J. J. Weigle, of the Westinghouse Research Laboratory.

ADJUNCT PROFESSOR P. M. BATCHELDER, of the University of Texas, has been appointed acting assistant professor of mathematics at Brown University for the academic year 1924–1925.

DR. OLIVER H. GAEBLER has been appointed associate in biochemistry in the department of chemistry in the State University of Iowa, and Dr. Earl R. Norris, instructor in the same department.

DR. P. B. SIVICKIS, professor and acting head of the department of zoology, University of the Philippines, was recently appointed permanent head of the department in place of Professor A. L. Day, retired.

DR. FRED M. SMITH, Chicago, has been appointed professor of internal medicine and head of the department of theory and practice of medicine at the State University of Iowa College of Medicine to succeed Dr. Campbell P. Howard, who resigned to accept the professorship of medicine at McGill University Faculty of Medicine, Montreal.

DR. ARTHUR W. M. ELLIS has been appointed to the university chair of medicine at the London Hospital Medical College. Dr. Ellis, during 1909–1910, was resident pathologist of the Lakeside Hospital, Cleveland, and demonstrator of pathology in the Western Reserve University School of Medicine.

DR. S. BRODETSKY, teacher in applied mathematics, at the University of Leeds, has been appointed professor of mathematics.

DISCUSSION AND CORRESPONDENCE

A MATHEMATICAL BLACK SHEEP

THE most noted mathematical black sheep is doubtless H. Cardan (1501–1576) whose name is usually associated with our common formula for the solution of the general cubic equation. In particular, he is often charged with having obtained this formula from Tartaglia under a solemn promise of secrecy and with having then published it in his noted "Ars Magna" (1545), in violation of this promise and without giving due credit to Tartaglia. Fortunately, some of the more recent mathematical historians have come to the conclusion that his actions in this connection are not as reprehensible as earlier writers had supposed. The formula which he obtained from Tartaglia may have been due to an earlier Italian writer named Ferro, and, in fact, this formula is called *Ferro's formula* in one of our best recent histories of elementary mathematics, Tropfke, "Geschichte der Elementar-Mathematik," Volume 3, 1922, page 73, and elsewhere.

In an article entitled "Psicologia dei matematici," published in a recent number of *Scientia,* Volume 35, 1924, page 10, the noted Italian mathematical historian, G. Loria, states that the autobiography of H. Cardan entitled "De vita propria" is of little value as a historical document in view of the fact that its author wisely abstains from replying to the charges made against him. Since the common biographical sketches are largely based on this autobiography many of the charges contained in these sketches have not been established. It seems very fortunate that the blackest sheep among the eminent mathematicians is thus slowly changing color for the better. This will be especially interesting to those who believe that the devotion to mathematical study has a tendency to nobler thinking and the improvement of morals.

In the article to which we referred, G. Loria emphasizes the fact that most of the biographical accounts of mathematicians, especially those relating to the thinkers of antiquity, have little historical value since they are based largely on anecdotes and grandiloquent praises of doubtful authority. This is of considerable interest in view of the fact that most of our general histories of mathematics devote much space to such biographies. From the fact that it is difficult to purge the literature from such obvious biographical errors as the one relating to the supposed welcome given by Regiomontanus to Copernicus, while the latter was in Rome (SCIENCE, Vol. 60, p. 82), it is clear that it is almost hopeless to eliminate the less obvious ones, especially when they relate to the less prominent scientists. Too many mathematical historians have accepted statements which appear plausible and can not be disproved at the present time

instead of restricting themselves to what is based on strong evidence.

G. A. Miller
University of Illinois

TRANSMISSION OF COWPEA MOSAIC BY THE BEAN LEAF-BEETLE

Observations on the occurrence of the bean leaf-beetle (*Ceratoma trifurcata* Forst.) indicate that this insect may be responsible for the spread of cowpea mosaic, a little understood but serious disease of cowpeas. This disease, which is now known to be present in Louisiana, Arkansas and Indiana, causes mottling and crinkling of the cowpea leaves. The injury is similar to that found on most other mosaic-affected, dicotyledonous plants, the leaves being greatly distorted and the internodes shortened.

Insects associated in greatest numbers with cowpea plantings showing disease included the bean leaf-beetle (*Ceratoma trifurcata* Forst.), the belted cucumber beetle (*Diabrotica balteata* Lec.), the green stink-bug (*Nezara viridula* L.), and the alfalfa-infesting treehopper (*Stictocephala festina* Say).

Preliminary experiments during 1921 proved that the bean leaf-beetle transmitted the disease, while tests with the green stink-bug and the treehopper were negative. Additional experiments performed in 1922 and 1923 further demonstrated that the bean leaf-beetle is a definite and efficient carrier of cowpea mosaic.

It was established that insects which had fed for one day on diseased plants and were then transferred to healthy plants transmitted the disease in practically every case. Beetles retained as controls and confined on healthy plants did not transmit the disease when transferred to other healthy plants. Some infection of healthy plants was obtained by inoculation with regurgitated juice or abdominal contents from beetles which had previously fed on diseased plants.

Unmistakable symptoms of the disease were found to appear on healthy plants within five days after the beetles had been introduced into the cages containing these plants, but the average period throughout the season was seven days. In a few cases mosaic appeared on leaves which were very small at the time of inoculation, but as a general rule, only foliage appearing subsequent to inoculation developed readily recognizable symptoms of the disease.

Some artificial transmission of the disease was accomplished by rubbing the leaves of diseased and healthy plants together. In a limited number of experiments mosaic was readily transmitted from diseased to healthy plants by inoculation with a needle.

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ALKALINE REACTION OF THE COTTON PLANT

Mr. C. M. Smith in an article, "Excretions from the leaf as a factor in arsenical injury to plants," read before the New Haven meeting of the American Chemical Society, has pointed out that dew collected from the cotton plant is alkaline.

It seemed possible to the writer that this alkalinity was connected in some way with the attraction of the cotton plant for the boll weevil. The following experiments were therefore tried.

The leaves and stems of young cotton plants were crushed and immersed in water containing a few drops of phenol-phthalein. No apparent alkalinity was produced. (Distilled water was not available.)

When the unbruised plant was placed in the water containing the phenol-phthalein it was found that the under side of the leaf, the tender buds and very tender stems showed an alkaline reaction distinctly apparent by the almost immediate change in color of the phenol-phthalein adjacent thereto. No evidence of such alkalinity could be observed on the upper side of the leaf nor on the older parts of the stems, etc.

The solution of the alkaline substance in the water was apparently heavier than the water, as a distinct tendency for the purplish color to sink was noted.

On exposure of the under side of the leaf to the sun for some hours no apparent diminution in the alkalinity of the under side of the leaf took place.

Some thirty or forty different kinds of leaves were next tried in the same way. Similar, though much less, alkalinity was noted only in the case of leaves from okra. Since the okra is related to the cotton plant and since the boll weevil can be forced to feed upon this plant, some significance may attach to that fact. It is known, however, that certain other plants are known to form alkaline substances.

It was not possible at the time to attempt to identify the nature of the alkaline substances. Nor were forms, blooms or bolls available. Even the possibility of selective adsorption having produced the apparent alkalinity was not excluded.

Mr. Smith seems to think that there is something in his analysis of the dew (showing calcium and magnesium carbonates and bicarbonates) to account for the alkalinity observed. Since both acid and normal alkaline earth carbonates are neutral to phenol-phthalein, this would hardly seem possible. Alkali carbonates, if present, would cause alkalinity. Careful examination should be made for the presence of an organic alkaline compound and to find if the alkalinity observed has anything to do with the preference of the boll weevil for the cotton plant.

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ON THE INDUCTION OF ANTIRACHITIC PROPERTIES IN RATIONS BY EXPOSURE TO LIGHT

In the issue of September 5, 1924, of Science, Steenbock published a communication bearing a title similar to the above. He reported that by irradiation he was able to activate fats which were "otherwise negative in preventing rickets" so that they were rendered active and effected a rapid healing of lesions.

In this connection I wish to call attention to a similar investigation which was reported by me at the meeting of the American Pediatric Society, at Pittsfield, on June 7. These experiments consisted of irradiating various fluids with the mercury vapor quartz lamp. The results were summarized in this paper as follows: "that it was found that cotton seed oil when irradiated for an hour at a distance of one foot had acquired antirachitic properties. In order to exclude the possibility that the effect might be due to an antirachitic potency of cotton seed oil, linseed oil was substituted and the experiment carried out in the same way—0.1 cc. and 0.25 cc. being given daily to each rat. The same result was obtained, namely the development of rickets when non-irradiated oil was fed and the prevention of rickets when the oil was given which had been irradiated."

It may be added that the potency of cod liver oil is also enhanced by irradiation. It will be seen that the experiments which we have reported brought about results in regard to antirachitic actions which are similar to those recently communicated in this journal.

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SCIENTIFIC BOOKS

Effect of Variations in the Assumed Figure of the Earth on the Mapping of a Large Area. Special Publication No. 100 of the U. S. Coast and Geodetic Survey. By Walter D. Lambert, Mathematician, Division of Geodesy.

The question of how much correction to computed geographic positions would be required in the change from one spheroid of reference to another with slightly different elements of definition is one that must always be considered by the practical geodesist.

This publication attempts to give some idea of the magnitude of such changes from a consideration of an area such as that of the United States. The amount of exact computation requisite even for this general view of the matter is considerable; these computations have been carried out with sufficient precision and they are of value as concrete examples for such as wish to undertake similar calculations.

Heretofore the formulas and explanations of such computations have been scarcely, if at all, available in English. It is therefore with pleasure that we note that this small pamphlet gives the formulas for such work with an explanation that can be followed with ease even by those who may not be actively engaged in such work. The geodetic study of the figure and size of the earth should be of direct interest both to the engineer in a practical way and to the scientist who should take an active interest in the advancement of knowledge along all lines.

A feature of the publication that is to be commended is the table of comparison of symbols used by various authors given on page 35. One of the things that is always discouraging in reading scientific literature is the use of different notations for the same thing by different authors. Not the least of such offenders against clearness are the mathematicians both pure and applied. This table is therefore of great value to those who want to look into this question without too much preliminary study.

Since this publication furnishes authoritative information on some rather intricate questions of geodesy, it fills a place in English geodetic literature that should appeal in a special way to the scientific world.

O. S. Adams

U. S. Coast and Geodetic Survey
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The Evolution of the Universe, or Creation According to Science. Transmitted from Michael Faraday, late electrician and chemist of the Royal Institution of London. Cosmos Publishing Company, Los Angeles, California, 1924. $2.50.

Michael Faraday, one of the creators of the science of chemistry and a pioneer in investigations of electricity, died in 1867, at the age of seventy-six.

It will interest chemists and physicists to know that "after transition" to "the scientific spheres of the Spirit World," Faraday has continued his investigations of the "Major Vortex," which is "with other planetary conditions only one state of the Entity," and especially in regard to electrons and the mastery of "the imponderable forces of nature which control the incarnation of a mortal without whose agency the world would roll on for ages in the idealism of the savage types of man and the entities that would be caught in the vortexical currents of the incarnating processes," etc. And all this without once calling on the resources of mathematics, which indicates that formulae and equations are emanations of the material mind.

Without anticipating the discoveries promulgated by the master chemist derived through fifty years of freedom from hampering conditions, I hasten to say that these were presented all or chiefly through "electro-magnetic" "independent slate-writing" to a gen-

tleman in Los Angeles, who chooses to be known as the "Mystic Helper," assisted by a friend, the "Mystic Scribe." The last message received (1911) from Professor Faraday reads:

> Through my cherished instrument I will continue my work bringing to mankind the greatest and most helpful thoughts gleaned from my long experience in this realm of truth.

The book is written in a kindly and tolerant spirit, accepting current theories of evolution, and going a long way farther. It closes with a rhapsody to evolution in which "the mighty soul of the Potent All guides all the worlds their endless rounds." A companion piece is the "Song of the Atom," which lets us down a bit from the "pure-ethered height" of the other poem:

> Come in line my brothers all
> Let us make the Earth a ball.

And a ball it remains to this day!

The volume is illustrated by photographs of nebulae and the like, taken by astronomers, by portraits of Faraday, Tyndall and Franklin, noted physicists, and by a number of spirit photographs not mentioned in the test. Some of these are conventional materializations, but others illustrate the creative work of electrons which in their varied operations appear in irregular forms pure white in color, and about as large as snowflakes. Students of heredity will be interested in the microphotographs showing the "formation of cell by induction of earth's magnetic currents," the process of mitosis being due to their influence. It is remarkable what electrons will accomplish when once released from bondage to "mortal electricians, like Edison, Marconi and many others."

The editor of this volume expresses the hope that Faraday "may be able to continue his efforts until intellectual spirituality animates every soul born into Cosmic Existence in or upon any planet that shall ever exist in Realms of Evolutionary Experience."

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LABORATORY APPARATUS AND METHODS

BLOOD CORPUSCLE MOVEMENT IN THE RETINA FOR CLASSROOM DEMONSTRATION OF CIRCULATORY CHANGES

No doubt many persons, when looking at a dull sky, have observed indistinct faint specks which appear, move in definite pathways across the field of vision and then disappear. Upon suddenly arising from a bending position, or after a sneeze, the specks may become quite bright and distinct. They are the moving blood-corpuscles in the retinal capillaries and their movement is quite different from that of small particles in the humors of the eye, often so troublesome to users of the microscope. Subjective observation of the retinal circulation has been frequently described, but the advantages of the following method for viewing this phenomenon, first recorded by Rood in 1860, are not generally recognized.

Upon looking at a bright sky through a dense blue-violet glass (such as Corning G 585–L), the movement of the corpuscles stands out almost as clearly as in the web of the frog's foot, but the corpuscles are not seen as objects of such definite form nor are capillary outlines visible. One observes bright specks, somewhat elongated, often curved like a vibrio. The whole field of view seems filled with a mass of writhing bacteria, sometimes accelerated in movement corresponding to the heart-beats.

Any brilliant white surface instead of the sky will serve as a background. One may look at the sun itself if additional filters are used, say G 585–L, G 586–A and G 584–J, when the corpuscles appear very bright. It is perhaps well not to gaze at the sun too long, for these filters are quite transparent to the near ultra-violet.

Changes in blood velocity connected with pressure changes are easily observed. Thus, if one suddenly bends over and looks at the sky through the blue-violet glass, the blood velocity is much accelerated; upon straightening up, the flow instantly slows down and then regains its usual rate. By taking a deep inspiration, holding the nose and exerting pressure on the thoracic cavity, the circulation may be seen to slow down and almost stop. The retinal circulation is an index of what is going on in the brain and illustrates the decreased blood-flow which precedes fainting, since fainting frequently follows any prolonged increase in intrathoracic pressure.

By lying on the back and having an assistant suddenly raise the legs, changes in blood-flow due to hydrostatic pressure of blood in the legs, with compensatory after-effects, may be demonstrated. By pressing on the eyeball with the finger, the circulation in the retina may be much slowed or stopped, and the bright specks disappear just before the whole field of view becomes black. On releasing the pressure, the circulation again starts at a rapid rate. Changes of blood-flow due to exercise and many other effects, which will occur to those interested in blood circulation, may be observed with great ease. The simplicity of the method commends it for classroom work, and the student usually takes great interest in viewing for himself blood velocity changes in

his own body. The clinician may find the method useful where subjective answers may be relied upon.

Just why the corpuscles appear as bright somewhat elongated specks is questionable. I first observed the phenomenon on looking at a carbon arc focused to a parallel beam, passing through a combination Corning ultra-violet filter (G 586–A and G 584–J). I thought the effect was due to fluorescence of the white corpuscles but am now certain that is not the explanation.

If a small field is selected for observation the bright points, whose elongation I attribute to persistence of vision, are found to be not sufficiently numerous for red corpuscles. They move over the *same pathway* at infrequent intervals and must be white corpuscles. Nevertheless, there is a definite relation between the absorption spectrum of haemoglobin and the light in which one can see the moving corpuscles most plainly. Abelsdorff and Nagel showed that the moving corpuscles appear in light which haemoglobin absorbs. Thus they are visible in blue-violet but invisible in red light. One should expect that with a blue glass the continuous stream of red corpuscles would throw a shadow of the capillaries on the retinal elements. Yet we see no evidence of capillary loops or plexus in shadow form. No doubt this is because the capillaries are so near the retinal elements that their shadow is fixed. In the classic method of demonstrating the shadows of the *large* blood vessels over the *surface* of the retina by looking through a pinhole at a white surface, the pinhole must be moved so as to continually cast a bloodvessel shadow over new retinal elements. When the pinhole is fixed no shadows are visible, although shadows are continually cast upon the rods and cones. This corresponds to the condition where a continuous stream of red corpuscles moves through capillaries in blue light. Although each red corpuscle moves, the corpuscles overlap and the shadow is continuous. But when a white corpuscle comes along which does not absorb blue light, as the reds do, we have a rift in the shadow figure which corresponds to movement of a shadow across the rods and cones, analogous to the movement of the pinhole in the demonstration of the *large* retinal blood-vessels. Thus we see the white corpuscles by contrast with the reds and see them best in light which casts the best shadow. Red light passes both the red and white corpuscles and no contrast appears.

It so happens that the brightest lines of the mercury vapor lamp (the yellow, the green and the blue violet) lie in the position of oxyhaemoglobin absorption bands. One can therefore see the moving corpuscles of the retina very well by looking at a white matt surface illuminated by a mercury lamp; or by appropriate filters one can isolate each line and observe the moving corpuscles in yellow, green or blue violet light.

I recommend the above simple experiments to any one interested in the circulation of the blood or in subjective phenomena. They deserve to be more widely known than appears to be the case.

The literature on this subject is as follows:

Abelsdorff, G., "Arch. f. Anat. u. Physiol.," 1903, p. 366.

Abelsdorff, G., and Nagel, W. A., *Zeit. f. Psychol. u. Physiol. des Sinnesorgane, 34,* 291, 1904.

Fortin, E. P., *C. R. Soc. Biol., 62,* 355, 1907.

Helmholtz, H. von., "Physiologische Optik," 2nd Aufl., 1896, p. 198.

Reuben, L., *Amer. J. Sc., 31,* 325, 1861.

Rood, O. H., *Amer. J. Sc., 30,* 264 and 385, 1860.

E. NEWTON HARVEY

WOODS HOLE, MASS.
AUG. 8, 1924

MICROPROJECTION BY THE DAYLIGHT SCREEN

IN the teaching of histology, organology and neurology the chief difficulty lies, not in making the students see the details of an organ, but rather in orienting for them the plane of section and the relationship of the main parts. It is next to impossible to persuade the student that a low power objective is far more important in the study of most sections than a 4 mm objective, and as a result he fails to obtain a true conception of relationships. Then, too, in personal demonstration six times out of ten the average student does not see that which you try to show him under his microscope. Again, it is impossible to properly demonstrate three or four slides in five or six minutes, which is the average time a demonstrator has per student in order to handle 15 to 20 of them. These difficulties, I am sure, are encountered not only by anatomists but also by embryologists and botanists.

It has been my experience that a short time spent during each laboratory period in projecting the slides to be studied, with a 48 mm, 25 mm or 16 mm objective and pointing out the plane of section and the relationships of the main structures will create an interest and give a viewpoint conducive to effective laboratory study. The best results are obtained by a ten to fifteen minute demonstration to ten to fifteen students at a time. Personal demonstration for this number of students would require from one and one half hours and would permit greater misinterpretation.

For the projection method of demonstrating sections the day-light screen is of great value, since it permits demonstration at one end of the laboratory without interrupting the work of the rest of the

students. The daylight screen now on the market has several objectionable features: in the first place, its lines are too coarse, thus destroying the details and also producing a glaring streak of light across it; in the second place the greenish tint destroys the true color value in arc-light projection; and in the third place the screen is too expensive. A screen which presents none of these objectionable features can be had in a piece of paraffined tracing-paper, a piece of paraffined tracing-cloth or a ground-glass plate.

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SPECIAL ARTICLES

THE PHOTOACTIVITY OF SUBSTANCES CURATIVE OF RICKETS AND THE PHOTOLYSIS OF THE OXY-PRODUCTS BY ULTRAVIOLET RADIATION

THE demonstration by Huldschinsky[1] and others that radiation with the quartz mercury vapor lamp or sunlight prevented and cured rickets, was a great advance in the knowledge of that disease. It had been proved also that cod liver oil prevents and cures rickets[2] and therefore the dilemma presented itself that two therapeutic agents apparently unrelated cure the disease. The one, a physical force derived from the sun, is absorbed through the skin, the other, an oil taken from the liver of a fish, enters the body by way of the alimentary tract. Nevertheless, investigation soon showed that in their action in rickets and infantile tetany radiant energy and cod liver oil are indistinguishable. No matter which of these apparently dissimilar therapeutic agents is employed, favorable clinical and roentgenological evidences of healing in rachitic subjects are demonstrable. With both, there is a similar latent period; with both, the normal equilibrium of calcium and inorganic phosphorus of the blood is reestablished; and furthermore, with both, the histological changes in the skeleton are identical. The similarity of the action of radiant energy and cod liver oil is so striking as to cause Park, Powers and Guy[3] to conclude, "The similarity between the action of cod liver oil and that of radiant energy in rickets is so close that a connection must exist between them. So far as the calcium and phosphorous metabolism of the body are concerned, cod liver oil seems to be a substitute for radiant energy. It will be most interesting to see if, in the near future, a relation between cod liver oil and radiant energy will not be established of such nature that these effects will be explicable on a single basis."

Investigations were therefore undertaken to determine the possible common property of radiant energy and the various substances curative of rickets. The present data is representative of a series of preliminary experiments for qualitative orientation and serve as a basis for quantitative study.

A. *The Emission of Ultraviolet Radiation by Substances Curative of Rickets.*

Method. Substances curative and non-curative of rickets were tested for their emission of ultraviolet light. They were placed in beakers and covered with specially prepared photographic plate holders. The plates were exposed to each substance for twenty-four hours, developed with pictol,[4] fixed, washed and dried.

The plate holder consisted of a shallow lead box of a size just large enough to admit the four inch by five inch photographic plate and a closely fitting cover of the same material. In the floor of the lead plate holder a hole two centimeters square was cut to allow the formation of a sharp photographic image. A quartz plate, either fused or transparent, was sealed over this aperture in such a way as to prevent the permeation of volatile substances from the test materials. Similar holders were made with glass screens. Ultraviolet sensitive plates[5] coated with a very rapid emulsion (Seed Graflex 60) were placed with the film surface in apposition with the quartz or glass screen and then covered by the lid. Each beaker covered by this plate holder was placed within a light-proof container which in turn was placed within a second light-proof container.

Three series of experiments were carried out on each substance. In the first series the substances were made alkaline with ten per cent. potassium hydroxide and this mixture was oxidized by bubbling through it a current of pure oxygen. In the second series the substances were untreated. In the third

[1] Huldschinsky, K., Deutsche med. Woch., 1919, XLV, 712; Zeitschr. f. Orthop. Chir., 1920, XXXIX, 426.

[2] Schabad, J. A., Zeitschr. f. klin. Med., 1909, LXVIII, 94; Shipley, P. G., Park, E. A., *et al.*, *J. Biochem.*, 1921, XLV, 343. Park E. A., and Howland, J., Johns Hopkins Hosp. Bull., 1921, XXXII, 341.

[3] Park, E. A., Powers, G. F., and Guy, R. A., *Am. J. Diseases Children,* 1923, XXVI, p. 111.

[4] Dissolve 3 oz. of desiccated sodium sulfite in 16 oz. distilled water and add this to a solution of 150 grains of hydroquinone in 8 oz. of distilled water. This constitutes solution A. Dissolve 2 oz. of potassium carbonate and 60 grains of potassium bromide in 16 oz. of water. This constitutes solution B. For use mix three parts of A with two parts of B.

[5] These are being replaced by Schumann plates for photographing the extreme ultraviolet region since gelatin exercises a very powerful absorptive influence upon rays of short wave length.

series they were reduced by ammonium ferro-tartrate. The beakers covered by the plate holders were placed in desiccators containing alkaline pyrogallol and were subsequently evacuated. These three series will be referred to as oxidized, untreated and reduced.

TABLE I

Results of the Fogging of Photographic Plates Exposed to Substances Curative and Non-Curative of Rickets

Reaction	Substances Curative of Rickets			Substances Non-Curative of Rickets		
	Quartz screen	Glass screen	No screen	Quartz screen	Glass screen	No screen
Oxidation	+	0	+	0	0	+
Air Autoxidation	+	0	+	0	0	+
Reduction	0	0		0	0	

Results. The following substances curative of rickets—cod liver oil,[6] non-saponifiable fraction of cod liver oil,[7] oxidized cod liver oil treated to destroy Fat Soluble A,[8] egg yolk,[9], bile,[10] hydroquinone,[11] and sperm oil,[12]—when oxidized produced a definite blackening on photographic plate screened by quartz but not on those screened by glass. The substances non-curative of rickets, namely linseed oil,[13] peanut oil,[13] cotton seed oil,[13] lard,[14] the saponifiable fraction of cod liver oil,[7] and also crude oil, albolene and glycerine when oxidized did not affect the photographic plate through either quartz or glass. All oxidized substances examined fogged plates exposed to them without a screen.

The untreated substances curative of rickets blackened a sensitive plate through quartz but not through glass, on spontaneous autoxidation by the air within the beaker. The intensity of the image was not so marked as with the oxygenated substances. The untreated substances non-curative of rickets did not fog the plate through either quartz or glass.

The reduced substances curative and non-curative of rickets did not fog the sensitive plate through quartz or glass. The substances curative of rickets whose absorbed oxygen was removed by bubbling carbon dioxide through them under reduced pressure produced but very slight fogging of the plate.

Blood also fogs the photographic plate through quartz but not through glass. The degree of blackening increases with the rate of oxidation and decreases when oxidation is prevented by passing carbon dioxide through the blood.

B. *The Liberation of Oxygen from the Oxidized Substances Curative of Rickets by Ultraviolet Radiation.*

Oxidation resulted in the production of ultraviolet rays and therefore an attempt was made to determine the reversibility of this reaction. The substances curative of rickets which were oxidized in alkaline media were placed in a quartz test tube connected to a Torricellian mercury column and radiated by ultraviolet light at room temperature for three hours. Under the influence of the radiation a continuous formation of gas bubbles within the quartz tube was observed with a gradual dropping of the mercury caused by the gas formed. This was found to be oxygen.

The photo-chemical equilibrium in an unstirred solution that absorbs all active ultraviolet radiation is independent of the intensity of illumination, as would be expected, but is entirely dependent upon the extent of the surface exposed to the light source.[15]

Photolysis of the oxy-substances curative of rickets was not detectable in solutions that had been exposed to the ultraviolet light through glass test tubes which transmitted none of the shorter wave lengths.

Therefore, the reaction which takes place when substances curative of rickets are radiated with ultraviolet light seems to be the reverse of that obtained in the previous experiments, namely the emission of ultraviolet radiation upon oxidation.

Summary. The data presented show that the substances curative of rickets, upon oxidation blacken sensitive plates through quartz but not through glass screens. This phenomenon is undoubtedly due to the emission of ultraviolet radiation. The interposition of quartz plates excludes the effect of reducing vapors which otherwise blacken the sensitive plate. The non-

6 *Loc. cit.*

7 Zucker, T. F., Pappenheimer and Barnett, *Proc. Soc. Exp. Biol. and Med.*, 1922, XIX, 167.

8 McCollum, E. V., Simmons, Nina, Baker, J. E., *J. Biol. Chem.*, 1922, 53, 293.

9 Hess, Alfred F., *Proc. Soc. Exp. Biol. and Med.*, 1922, XX, 369; Casparis, H., Shipley, P. G., and Kramer, B., *J. Am. Med. Assoc.*, 81, 818, 1923.

10 Kapsinow, R., and Jackson, D., *Proc. Soc. Exp. Biol. and Med.*, 1924, XXI, p. 472.

11 Huston, A. C., and Lightbody, H. D., *J. Ind. and Eng. News*, April, 1924.

12 Personal communication from Professor E. A. Park. —"So far as we are aware, sperm oil has never been tested for anti-rachitic property. However, Drummond (Biochem. J. XVI, 518, 1922) found it to contain Fat Soluble A. It is highly probable that the oils of all fish have anti-rachitic properties."

13 Mellanby, E., British Med. Research Council Report No. 61, 1921, 22.

14 Personal communication from Professor E. A. Park. —"Lard has no specific anti-rachitic effect." (Unpublished work).

15 W. T. Anderson, Jr., *J. Am. Chem. Soc.*, 1924, 46, 801.

blackening through glass screens excludes the emission of both radioactive and visible rays. The necessary conclusion is that upon oxidation ultraviolet rays are produced.

The degree of blackening is apparently a function of the rate of oxidation for the intensity of the image from vigorous oxidation is greater than that from spontaneous oxidation within a given time. The blackening is also a function of the hydrion concentration for the intensity of the image is greater from alkaline medium than from neutral or acid media.

The experimental data further show that the oxidized substances curative of rickets when exposed to ultraviolet radiation liberate oxygen. Therefore the photochemical reaction appears to be reversible and may be expressed by the equation, Oxygen + Rickets-curing Substances ⇄ Oxy-Substances + Ultraviolet Rays.

These experiments point strongly to the common property of emitting ultraviolet rays, of cod liver oil, egg yolk, sperm oil, bile, hydroquinone on the one hand and of sunlight or quartz mercury vapor radiation on the other, as the basis for their identical curative action in rickets.

The experiments recorded may be applicable to physiologic phenomena in general. Not only do they suggest the mechanism common to all rickets-healing processes and imply a method to measure the therapeutic potency of the curative agents but they also disclose the fact that solar energy exerts a hitherto neglected function in the physiology of higher organisms as well as in plants.

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THE EFFECT OF INTRAPANCREATIC ADMINISTRATION OF GLUCOSE ON THE BLOOD SUGAR CURVE

THE normal stimulus to the assumed insulin-producing function of the island tissue of the pancreas is as yet undemonstrated. A possible stimulus is the sugar carried to the gland by the blood. Work already published from this laboratory has paved the way for a direct attack upon the problem.[1] The curve of the change in sugar concentration during the two or three hours following the ingestion of glucose has long been used by clinicians as evidence in the diagnosis of underfunction of the insular tissue. Since the rate of absorption of ingested sugar into the blood stream can not be controlled, however, continuous intravenous injections of glucose at the rate of 0.7 gram per kilo of body weight per hour were used, and the course of the curve of blood sugar concentration was studied during the injection. Dogs were used for the experiments. The sugar was introduced into a superficial leg vein. A total of 30 to 50 blood samples was taken during an injection period of two and a half to five hours. These were analyzed in duplicate by the Schaffer-Hartman method. The blood sugar curve thus determined was of materially different form from curves following the alimentary administration of glucose. The typical alimentary curve, as is well known, rises in the first half hour, then returns to fasting level in about three hours. The curves during continuous administration by vein rose similarly but remained elevated throughout the period of injection. Twenty-two such experiments yielded only one curve that returned to the initial level. Having established the average level reached and maintained by the blood sugar curve during injection into a peripheral vein, it was sought to subject the pancreas to a higher concentration of sugar in the blood without, however, increasing the quantity injected, by introducing the sugar into an arterial channel leading to the pancreas.

The animals were anesthetized with isoamylethyl barbituric acid, a substance reported to be without disturbing effect itself upon the blood sugar level.[2] This report was verified in several experiments in which the original route of injection, into a peripheral vein, was used. In the experiments here reported glucose solution was directed into the blood stream supplying the pancreas by injecting it centrally into a collateral duodenal branch of an artery supplying the tail of the gland, or else by injecting it upstream into the splenic artery, and thus via another branch of the celiac axis into the pancreatic circulation.

Eight technically successful experiments have been performed. Four of the resulting curves were not greatly dissimilar to those obtained during injection into a leg vein. Four others, however, rose to a height either equal to or below the average level reached during peripheral injection, then fell steadily to and below the initial level, despite the continuation of the injection. In form and in duration these latter curves closely resemble those resulting from administration of the sugar by mouth. One of these showed so little elevation as to suggest the type seen after alimentary administration of fructose. These four curves are interpreted as evidence of a greater discharge of insulin than occurred in the experiments in which injection was made by peripheral vein.

Further investigations of the problem are in progress.

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[1] E. C. Albritton, *Am. J. Physiol.*, 1924, in press.

[2] I. H. Page, *J. Lab. & Clin. Med.*, 1923, 9, 194–196.

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CONTENTS

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PROSPECTS AND RETROSPECTS[1]

It is a time-honored custom that, once a year, the president of the American Chemical Society should deliver a "presidential address." As the years roll by, the list of these addresses has become quite formidable and various subjects have been touched upon by my distinguished predecessors. But through many of them runs an ever recurring trend of thought relating to the problems and scope of chemistry in America, from the standpoint of each period at which the different addresses were delivered.

In masterly presentation, in broadness of view, or in confidence in the future of our science, I doubt if any of these addresses have surpassed the first of them all, delivered in 1876 ("Science in America," *J. A. C. S.*, Vol. 1, 1877) by our earliest president, John W. Draper.

In some of these addresses, difficulties were pointed out or doubts were expressed as well as optimistic wishes. To-day, after I have reread every one of them, I find comfort in the fact that the most cherished hopes of earlier years have already become a solid reality.

We may well devote a few minutes to this subject before we touch upon other matters. Our growth has been enormous, nevertheless it was gradual. Even in 1890, after fourteen years of existence, we counted only 256 members. At that time we printed a modest journal, hardly known then outside of the United States. To-day, our membership, approaching 15,000, exceeds by far that of any other chemical society in the world.

The scope and variety of our publications have increased in the same way. Besides our older journal, which now mainly prints subjects concerning purely theoretical research, we have our *Journal of Chemical Abstracts* which since 1906 has made us the only country independent of the heretofore indispensable German *Chemisches Centralblatt*. Then in 1909 we launched our *Industrial and Engineering Chemistry*, particularly devoted to applied chemistry or scientific research related thereto and which lately has been reinforced by its semi-monthly supplement, the "News edition." Nor should we fail to mention the *Chemical Monographs*, published in book form, and the more recent *Chemical Review;* truly a handsome list of publications covering every department of chemistry—and which have acquired such interna-

[1] An address delivered by the president to the members of the American Chemical Society at the September, 1924, meeting, held at Cornell University, Ithaca, New York.

tional importance that no chemical library can be considered complete without them.

I feel no hesitation whatever in making this short survey of our flourishing condition, because I know very well that in this matter I can not assume any personal credit, beyond that which belongs in common to every one of the thousands of devoted members of the past and the present, who have helped to bring our society where it stands to-day.

But I want to put special stress upon the fact that this healthy growth of the American Chemical Society came from within, from the spirit of its own members. We had to rely on our own efforts without any outside help or gifts or subsidies.

If it were not for that inner spirit of cooperation and high purpose, our society could not continue to exist in its present robust condition. With its sixty-nine local sections spread out over the vast territory of our Republic; with its fourteen divisions covering as many special fields in chemistry; with each section, each division, autonomous in action within certain limits, each having its own chairman, we practise a method of decentralization leaving abundant scope for initiative, yet requiring a community of purpose subordinate to a general plan of action. This plan of action is formulated by the council of the society where every section, however small, has its representatives who express and decide the general policy and aims of the society.

The magnitude of the present responsibilities incumbent upon the business management of the society seems rather obvious by the fact that our yearly expenditures amount to about \$370,000; more than a thousand dollars every living day. Most of this money is spent on our publications, relatively little on salaries. The details of the expenditures are set forth in our yearly published balance sheet.

The greatest single work of the society has been the dissemination of chemical literature. Our publications are not undertaken for monetary gain so that our main source of revenue still consists in membership dues. Our income and expense accounts balance rather closely at the end of the year and we are compelled to use the interest money of our surplus funds for this purpose. This in itself is quite an achievement which has only been possible by paring expenses and by most devoted business management.

I do not present these statements so that we may rest on our laurels and indulge in self-satisfaction, but so that they might spur us on to further efforts and to new opportunities of service.

Our present resources are becoming too scant to keep pace with the rapidly increasing chemical literature which has to be reported in our *Chemical Abstracts*. The same can be said of our other journals where valuable papers from our members have sometimes to be refused for publication on account of lack of space. Yet the most important purpose of our journals is to publish chemical information. It is quite significant that the greatest increase in our membership dates from the time when we extended this service by the publication of our newer journals. During the latter months plans for securing additional funds have been devised which are now ready to be put into operation.

The American Chemical Society through its members has much helped to develop or to create various industries in this country where chemistry plays an important rôle. It has also contributed in no small measure to extend and to perfect our methods of teaching chemistry in our universities and engineering schools, thus furnishing to the nation an increasing number of men better fitted for the research work and the chemical engineering fundamental to our industries as well as to the development of our science.

The period when Americans were compelled to go abroad to study chemistry has long since passed. It was quite natural that the United States should have had to evolve through the same phase through which Germany had to pass when in 1822 Liebig had to travel to Paris and study chemistry there under Gay-Lussac, Dulong and Thenard. Later on, the disciple became himself a master in his own country. But the great development of chemical science and chemical research which followed in Germany would hardly have been possible but for the new favorable conditions brought about by the early manufacture of synthetic dyes in that country after the original discovery of Perkin in England. The very nature of that new industry put an unprecedented premium on research in organic chemistry. Fame, honors and monetary rewards were the alluring inducements offered to the best available chemical talent in Germany. No wonder then that startling discoveries occurred in rapid succession. The organic chemist had suddenly become more important than the engineer who heretofore had been guiding the destinies of the older well-established soda and acid works. Whether we like to admit it or not, much of the history of science has been shaped by the needs and the outside influences of commerce or industry.

But the importance and the money value of the German dye industry were not the only factors which brought about this result. Some of the men at the head of these chemical industries in Germany were chemists of no mean ability, who by their very training were able to realize how most of their business problems were immediately dependent upon the latest discoveries in science, and who could think as chemists as well as business men, an art not easily acquired.

Nor is it astonishing that not only in Germany but

also in other countries some of the most successful chemical enterprises were mainly owned and directed by men well trained as chemists or as chemical engineers.

Such men succeeded in building up their chemical enterprises with a broader perspective, a greater attempt at permanency and a congenial feeling toward their work. In other words, their business was not merely a means for immediate gain; nor were they ever ready to toss over their holdings in their company to the highest bidder as soon as a better field for money-making presented itself.

I believe that in the future the most permanent chemical enterprises in the United States will be those in which chemists and engineers of ability play a considerable part in the general business policies.

This does not mean that chemical enterprises directed exclusively by men who are chemists but who lack sound judgment or business common sense are likely to be successful. Examples to the contrary make up the endless story of wrecks and unsuccessful ventures in the chemical industries of every country. Some of the most exalted names in chemical science have been connected with such defunct enterprises.

Scientific thought often compels intense concentration on one single subject, one single factor of a many-sided problem. To some scientists that single factor may appear of paramount importance while other equally important factors entering into a practical problem are apt to be underestimated.

Any such one-sided points of view may cause little harm to their author in the publication of a book or of a purely scientific paper, even though sometimes they result in stubborn scientific polemics. Stubbornness in purely scientific points of view is not always easily cured, and sometimes clings like a dogma; but the man of affairs or the industrial chemist who refuses to be taught by his mistakes risks ending in the poor-house.

These considerations, simple as they may be, have not unfrequently been overlooked by men of great erudition and superior intelligence who in their career as teachers or writers or research workers were able to live by themselves in a world confined by their lecture room, their library and their laboratory.

If such men are given opportunities to cut their teeth on some practical problems they may grow to be of decidedly greater service to their science or its applications.

It has been my privilege to live and work amongst every kind of chemist and I have known of very few instances where a chemist exclusively engaged in purely theoretical work did not broaden his conceptions and increase his abilities after he had been given an opportunity to deal with a practical problem. Some of the most distinguished of them only attained their full value as teachers or research men after they had become consultants on problems of applied chemistry which taught them to grapple with hard, real facts instead of basking in the sun of self-satisfying hypothesis.

Far be it from me to urge the teacher of chemistry or the investigator of purely scientific problems to sell his birthright for a mess of pottage. Any one who looks in chemistry for nothing but a means of getting rich has chosen the wrong career. The same efforts would lead him sooner to that goal by following more direct money-making pursuits which do not require such a long and difficult preparation.

All these considerations point to another phase of the great mission of the American Chemical Society, by its drawing together of all chemists in whatever different line of work they may be engaged. Undoubtedly, the present age requires specialists, but the most limited being as man or citizen is the over-specialist.

The gospel of research has now been so well preached in the United States for so many years that to-day no other country spends so much money and effort along these lines in industrial as well as in educational and special research institutions. On the other hand, I wonder whether our efforts towards good teaching, good lecturing on chemical subjects, have not relaxed somewhat. Teachers who captivate their classes and arouse enthusiasm for their subject have never been very common among chemists and, I should add, physicists.

Dull and uninteresting presentation of some of the most inspiring conquests of science occur too frequently. Even in very elementary lectures on chemistry or physics unnecessary recourse is frequently made to exclusively mathematical methods which makes it easier for the teacher, but the lack of visualization, the very spirit of the subject, is often lost upon his hearers. Pasteur, Tyndall, Huxley and Darwin used the simplest possible language when explaining science to the general public. They were not afraid of making science accessible to everybody. If more scientists had followed their example, science might have had a more humanizing effect on the present generation. Many people who glorify themselves in a purely literary or artistic education might have been kept in closer touch with the trend of our modern world. They would have been able to realize that it is idle to dream and think and act in the spirit of past centuries, that it is dangerous to cling exclusively to teachings of the history of long disappeared ages while in our problems of to-day and to-morrow we are confronted with new conditions,

new possibilities so radically different from the life of the past and all created by the developments of scientific investigation and invention. Whether we like to or not, we must adapt ourselves to these newer conditions which also shape our newer duties. If not, we place ourselves in the same dangerous attitude of those Bourbons of whom it is said that "they could not forget anything old and could not be taught anything new."

Science, and chemistry in particular, has been repeatedly reproached for all the horrors of the late war, for all the present unrest, dissatisfaction and—what not? By whom? By the very people who have least tried to grasp the immense strides of our knowledge and the undreamt-of new powers it brings along; by men who have failed to perceive in time the vastly increased responsibilities the new powers involved.

The militarists and politicians who started the European war were steeped in Bourbonism. They knew all the tricks of former wars. If they knew anything, it was the political history of the past. At best they were thinking in terms of the eighteenth century instead of the twentieth. It did not appear obvious to them that the wars of Napoleon were much nearer the conquest of Gaul by the Romans than 1870 was to 1914. Unfortunately, just that class of people ruled the destinies of nations.

If they had been able to contemplate the awesome responsibilities of the present age they might have hesitated starting that conflagration. Chemists certainly did not start nor encourage that war. They were called in only after the conflagration seemed to get beyond control. Some clergymen and some moralists now reproach us for our science—they say that we have not grown up fast enough with our moral responsibilities. Some of them have gone as far as to suggest that we should stop teaching science and research in our schools and that we should find our mental food exclusively in the classic lore of the past. It does not occur to them that theologists and preachers in Germany were amongst the most rabid jingoists. That great educator and philosopher, Dr. Charles W. Eliot ("A Late Harvest," The Atlantic Monthly Press, Boston), writes: "For the last six hundred years the Christian nations have fought oftener and harder than the so-called heathen. Within the past two centuries all the great wars have been fought on Christian soil by Christian soldiers."

After all, the men who belittle science do not appear very different in their attitude from the so-called noble Indians who, proud and blissful in the traditions of their successful tribal wars and their skillful use of bows and arrows, were suddenly confronted with cannon, rifles and gun powder which had come into existence without their knowledge.

We must not overlook that potent factor that our present generation, even in the most civilized countries, is extremely heterogeneous, although all wear the same clothes and externally seem rather alike. The great majority amongst us have been dragged into a civilization into which they do not belong; for which they are not prepared. Under the surface run the thoughts and aspirations of past centuries, an attitude utterly irreconcilable with the new conditions which have arisen in the meantime. This state of mind is bad enough with the average person who meekly realizes his lack of knowledge. It may become supremely dangerous with the man or woman of power who has had a classical college education and who remains unaware that we live in an entirely new world and who stubbornly continues to think and argue in terms of the past.

Our new means of communication and transportation, and the latest engines of destruction, chemical and mechanical, have upset all former conditions of war. At the same time our cities, our industries, our agriculture and our whole modern civilization are all based and organized upon the endless applications of science and are decidedly dependent upon peace. Similar to a delicate watch, one single broken cog will stop it all. Men have quite a different impression about war, according to whether they are in the front line trenches or whether they read about it casually in the newspapers or if they are nicely sheltered in distant cities or live with the staff at general headquarters.

For the first time in history London and Paris had a slight demonstration how bombing airplanes can mock city walls, fortifications, or warships. But these were only some of the merest beginnings amongst the many new tricks which have become available since then.

Any one who is acquainted with later developments of the means of scientific destruction knows very well that the limit has not yet been reached, and that in future wars nobody will find a snug place where he may think he is safe or can escape the consequences. The largest and best protected cities, irrespective of their size or distance, will be continuously exposed to destruction and mutilation. Death and torture of the inhabitants will occur whether they are slumbering in their beds at night or whether they are reading their newspapers in their comfortable clubs or saying their prayers at church. There will be no way of safeguarding women or children or the old or the infirm.

But the remedy to these horrors lies not in stopping the use of chemistry in warfare. Chemistry has been used in war since early ages. Whether it was under the shape of the stinkpots or gunpowder of the Chinese against sword or bow and arrows, or whether it was the twentieth century chemical methods, in every instance the soldiers who were subjected to it at first indignantly protested, until pretty soon they used the same or even more drastic means in return.

The greater remedy seems to be more of a plain generous week-day religion of deeds, rather than a Sunday religion of words; less hypocrisy, haughtiness, lying and suspicion, and more decency and good will amongst peoples, in place of smug pedantic theology.

But do not blame the chemists for what will happen if irresponsible, tactless politicians or writers continue needlessly to arouse the worst feelings in other nations. Pin pricks hurt as much as stabs. But after the harm is committed the chemist as well as the soldier and the sailor has no choice left but to do his part and to help straighten the mess into which they have been drawn by the silliness or boorishness of others.

In the meantime these reproaches recklessly hurled at us should not make us lose faith in the noble purposes of our real mission. At the recent meeting of the British Association for the Advancement of Science, one of Britain's most distinguished physicians stated that every town in the world owes a statue in gratitude to Pasteur, the great French chemist. The rôle of chemistry is essentially constructive; to make this world more comfortable, happier and better to live in, to elevate the human race. Never has our field along these lines been more promising than today. I am not one of those who tends to exaggerate the benefits of chemistry in the creation of thousands of new synthetic dyes except for the enormous fund of new chemical knowledge we have gathered thereby and which has helped immensely in other more valuable directions.

In the meantime our fickle and over-dyed world now seems to have been supplied abundantly enough. Incomparably more promising fields beckon us to better endeavors. Amongst those fields none is more inspiring than that of the biochemist. Biochemistry, one of the younger branches of our science, has been confronted by many handicaps and its progress has been necessarily slow. It is still harassed by great experimental obstacles, but the newer revelations, technique and methods of other departments of science are now being used there to excellent advantage. Lately the study of the chemistry of endocrine glands seems to open the most startling possibilities.

If our predecessors in science scarcely ventured to foresee the realities of the present in what were then called visions or idle dreams, what dreams of the future may we indulge in if the mere chemical functions of some gland may make a man good or bad, strong or feeble, intelligent or stupid, peevish or happy, courageous or cowardly, generous or greedy?

Shall the biochemist become gradually a factor in the elimination of our houses of correction, our poor houses, lunatic asylums, as well as in the organization of our educational institutions? Who knows?

L. H. Baekeland

THE NEEDS OF PUBLICATION IN TROPICAL MEDICINE[1]

A critical survey of all the publications in the world devoted to tropical medicine would be an attractive and desirable achievement, but it is more of a project than I can undertake at present, and instead a few observations are submitted on the records of the English-speaking countries. These records are, of course, only a small part of the expression of creative racial energies in our civilization as a whole. They are of great significance, however, because many social as well as individual failures in the tropics have been due to the neglect or lack of scientific medicine, while many successes can be credited to its cultivation.

Practically all our special records in tropical medicine have been born in the last thirty years. In other words, we are in the midst of a movement and can not fully appreciate just what is going on. The message of science, however, is that man's life on this globe is more or less in his own hands, and it is indicated to see, if possible, in what direction we are traveling.

In view of the proved economic value of scientific medicine in the tropics, it might be thought that adequate avenues of expression would be provided. It might be thought that the recording of the precious workings of consciousness would be a first consideration. Such, however, is not the case. While a good deal has been done along these lines, too often immediate results and financial and administrative factors are given precedence. Scientific records are apt to be the last to be established and the first to feel the cut of economy. For example, it has been reported that some of the medical records of the Panama Canal Zone have been discontinued as not necessary for the operation of the canal. Again, when a study has been made, an author often has difficulty in placing his work. If finally placed, it may be delayed many months in publication and the author may have to share the expense. Many publications are operating on a slender margin, and editors have a difficult time between pressure for reduction of expense, on the one hand, and on the other the demands of the subject for adequate and dignified expression.

What is to be said about this situation? If scientific medicine is really so valuable in tropical civilization, its fruits should be guarded and treasured.

Of course scientific publication, like everything else, must in a measure make its own way in the struggling world. There is a healthful and saving

[1] Read at the International Conference on Health Problems in Tropical America, at Kingston, Jamaica, under auspices of the Medical Department of the United Fruit Company, July 23–31, 1924.

element in the struggle for existence, but it should not be necessary to fight over the same ground indefinitely. Now that the scientific approach has proved its value and possibilities, it should be made easier rather than obstructed.

In surveying the situation, we come sooner or later to the responsibility of the individual worker. Before asking the world to accept our currency, we should see to it that it has a par value. There is a constant need for the self-criticism and self-discipline which Pasteur so often insisted on. Scientific work has now a certain place, but many workers abuse the privileges of their position. They string their stories out to an unconscionable length. They take side trips up blind alleys and substitute egotism and personal idiosyncrasy for the serious and noble ideals of conscious effort. In recording scientific work, it is impossible to make a cinematograph of every move in the laboratory or at the bedside or in the operating room. The world can justly demand that the worker furnish only the really valuable and significant products and that the wastebasket be duly patronized.

Granting that some struggle for existence is desirable and that the individual worker plays the game fairly, what can reasonably be expected in this field of human endeavor? A brief survey of existing means of publication will bring out some of the possibilities.

Records of tropical medicine can be classified as follows:

(1) Articles in general journals or publications. Some of Ross's first work was reported in the *Lancet* and in the *British Medical Journal* and Reed's first report was in the Proceedings of the American Public Health Association. Of course, any general journal is willing and eager to publish important papers from any field of medicine, but the significance of some work is not always apparent at first and much solid work has no general appeal. The editor of a general journal can not be expected to give much space to exotic subjects. There are, of course, some general journals published in the tropics or subtropics which help the situation. The drawback to these journals is that they are apt to be local in circulation and therefore to have a somewhat limited if not a precarious existence.

(2) Special journals, which may be subdivided into (a) Popular journals, (b) research journals.

The best all-round journal is the *Journal of Tropical Medicine and Hygiene,* founded in August, 1898, as a monthly and now published as a bi-weekly. It had its struggles at first, but now seems well established. It contains editorials, personal notes and some reviews, as well as regular articles. This journal has for years been a welcome arrival to many physicians in the tropics. A counterpart in American literature would be desirable.

Most of the journals, such as *Annals of Tropical Medicine,* the *Indian Journal of Medical Research,* the *Philippine Journal of Science* and the *American Journal of Tropical Medicine,* can be called research journals in the sense that they present chiefly studies of subjects rather than clinical experiences and contain little or no personal matter, editorials or reviews. The subject of reviews will be taken up later, but it is believed there is a place even in these journals for personal notes and for occasional editorials.

Efficiency and progress depend on specialization, and specialists require some medium of expression. This is best secured through special publications. The stimulating effect of special journals is well known. But, of course, there is a limit to the support of such publications, and one of the great troubles of the present is that there are so many special journals struggling to exist in various fields of medicine that they overlap and compete with each other and eventually some of them have to drop out. Some 1,900 journals are received each year at the Army Medical Library. This is a larger number than would be allowed as necessary by a super-censor of scientific matters. The field of tropical medicine is large enough to support certain media of expression but not large enough for much competition. Cooperation rather than competition is needed with specialization within the field. By a gentleman's agreement or otherwise, certain kinds of work should appear in certain kinds of publications.

(3) Reports of organizations, like the Isthmian Canal Commission and the United Fruit Company, which contain much valuable material mixed in with other matter of less general interest. If these publications are to have the best standing as professional publications, the scientific material should not be buried with administrative and statistical matters but should be dignified as in the latest report of the United Fruit Company by a separate section, and in many instances summaries should be published in standard journals. Attempts to curtail these publications, like the recent one on the Canal Zone, should be resisted with all our influence. Once started, these reports become indexes of progress and afford an important means of yearly comparison which should by all means be perpetuated.

(4) Government reports. Some government reports, such as those of India and the British Colonial Office, are standard scientific publications and are issued in suitable form. More often, however, scientific data are effectively concealed in a husk of routine matter. Another way of burying data is to put it in a confidential report. Other reports are so

inconclusive that they are appropriately buried in the files. Anything of significance should be brought out into the daylight of current information, either in an established series of scientific reports or in recognized scientific journals.

(5) Bulletins of institutions and schools, like those of the Wellcome Research Laboratories and the Liverpool School of Tropical Medicine.

These can be classed as standard publications, and members of the staffs of these institutions are fortunate in such facilities. But many series of bulletins have come to an untimely end and remain dumbly on library shelves like the blind ends of extinct lines in charts of organic evolution. Scientific medicine has a survival value in our civilization which should be reflected in our records.

(6) Proceedings of the societies, congresses and conferences. These serve a most useful purpose. The proceedings of the Royal Society of Tropical Medicine are a model of interest and technique of publication. The records of congresses and conferences are mines of information if sufficiently distributed and not too long delayed. The plans for the record of this unique conference show the fullest realization of the title of this paper.

(7) Abstracts. The material scattered about in the various publications which have just been roughly outlined evidently needs to be brought to a common focus. This is wonderfully accomplished by the *Bulletin* of the Tropical Diseases Bureau. It is difficult to praise this publication too highly. Practically every written record is reviewed, and in addition the reviewers often give a critical opinion of the work. This seems to me a much needed feature in abstracts, but one seldom attempted. Of course it can be abused, but a fair criticism by a competent reviewer would help keep our records straight. The editors are to be congratulated on this work. Another most valuable feature is the summaries which are given in each subject at intervals by experienced workers. Altogether this abstract journal is all that could be hoped for and makes the ordinary fragmentary review section seem inadequate. This bulletin can not be competed with nor dispensed with. The Referate of the German *Centralblatt* attempts something of the same kind, but it is questionable if they can reach again the position they held before the war.

(8) Although this survey is concerned with the publications in English, reference should be made to the bi-weekly Spanish edition of the *Journal of the American Medical Association* which has been issued since 1920. The *American Journal of Tropical Medicine* since its foundation in 1921 has also published summaries of each article in Spanish. It is difficult to say just how valuable these measures are, but they stand for an attempt to recognize the important place that Spanish civilization holds in Pan-America.

(9) Some mention should be made of books. This field is well covered for general use by Manson's classical work and Stitt's condensed manual. For reference, we have Castellani and Chalmer's encyclopedic work and Archibald and Byam's "System." The cost of the latter work, however, about $40.00, suggests some of the difficulties which editors and publishers face in covering this field. Valuable as books are in their place, they can not replace other publications any more than a letter can replace a telegram. Even journals can not keep up with the rapid developments, and parts of books are obsolete before publication, and new editions are regularly needed.

It will be noted that a number of these publications have the support of institutions and this is very necessary in these days of increased cost of illustration, tabulation and publication in journals. Several of these journals, however, are simply struggling individual journals. If you will allow a personal remark, it is a matter of record that the secretary-treasurer of the American Society of Tropical Medicine and the editor of the journal each receive $25.00 a year for their labors. It is encouraging to note that philanthropic support of medicine is beginning to include publications as well as buildings.

After all, the individual is the conscious unit and while mass effort and equipment are justly emphasized, the battles of science are fought and won or lost by the struggling personality. The individual worker should be encouraged by prompt and adequate publication. On the other hand, the editor must see that the urge of the ego does not interfere with the social aim to be achieved by the work.

In short, my argument is for increasing recognition of and organization in publication in tropical medicine. Along with expenses for buildings, laboratories, physicians and workers, the budget should provide for means of record and transmission. Folklore methods have no place in science. When a new institution or school is founded, means of publication should be carefully considered. If the budget is sufficient for a permanent series of bulletins, these should be provided for. Otherwise, existing agencies should be used.

In the swirl of modern life an emphasis on ideals and standards is more than ever needed. Medicine has too great a mission to allow itself to drift in the matter of records. There should be regular ways of record from the first flicker of an idea in the brain of the worker, through the society or journal to the abstract journal and the world at large.

The author of "The Grand Strategy of Evolution," in a striking passage on humanity as an organism, the new social Leviathan, says:

The universe is its habitat, the earth its den, and the

earth like an egg, is a well-provisioned residence. In the narrow cleft, between the more substantial earth and the blanket of its enveloping atmosphere, it lives and moves and multiplies; riding free the currents of terrestrial circulation; creeping into inviting valleys; crossing nature's bridges as they emerge; and following up the favoring shores of ancient causeways; spreading out where life is easier in denser racial spots and larger sprawling patches; linked over no-man's land by thread-like filaments of interlacing traffic; or intermingling hostile bloods, and merging spots and patches into one, the living film at last grows around the world, shutting in its cosmic heritage. East then meets west, and north meets south on common territory.

As this process goes on and man becomes more conscious of his destiny and more able to control it, how necessary it is that consciousness applied to physical and mental ills of the vast tropical zone shall have sufficient means of record. How urgent is the need for the encouragement of the individual worker in the hot countries by adequate publication of worthy efforts! Such are the motives which should animate our editors in their particular labors.

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MUSICAL ECHOES

The description of "Analyzed sounds in nature," by Professor Alexander Forbes (Science, July 4, 1924), calls attention to a very interesting and very beautiful phenomenon. It has remained until now practically unknown. The description in the poem of Emerson, which Professor Forbes quotes, is both of fine literary quality and also scientifically precise; but the reader would scarcely infer from it that the fact referred to is a definite thing in nature, distinct from the ordinary echo, and well worthy of search by every lover of nature who wanders among the hills.

My interest in this matter was first aroused during a visit to Sicily in 1900. There, at Syracuse, is a quarry in which, as we know from the history of the Greek wars, were confined 7,000 "beautiful Athenians" captured from the invading army sent at the instigation of the demagogue Alcibiades. From death there only those escaped who, as slaves to the Syracusans, could recite passages from the then fashionable plays of Euripides. In the wall of this quarry is hollowed out a cave of a peculiar trumpet shape, large below, but narrowing and curving upward to a small opening at the upper level. Here (by tradition) was wont to come the tyrant Dionysius, who a few years later established the empire of Syracuse over all Sicily and southern Italy, and himself as its master. Listening at this small opening he could hear distinctly not only the groans but every whispered secret of his political enemies imprisoned in the quarry and cavern below. The cavern is called the "ear of Dionysius." The lower chamber of this enormous trumpet is entered from the floor of the quarry and is (or was 25 years ago) closed by a wooden door. Slamming this door or even clapping his hands, the guide demonstrated the extraordinary reverberations which for some time afterward rolled about the cavern. These reverberations were of quite different quality from the original sound causing them; they were musical tones with suppression of all mere noises. He also asked that some member of the party of sightseers sing a scale or a bar of a few notes; and thereupon occurred, not an echo in the sense of a reproduction of the original sounds of the voice; instead it was as if on a mighty organ in a cathedral many stops had been opened in various combinations and sequences.

Two years later, during a summer vacation at Mt. Desert on the Maine coast, the climbs among its hills afforded me opportunities for observing the phenomena of analyzed sounds, or musical, or spectral echoes in nature. Indeed, the search for positions in which they could be elicited added interest and pleasure to the walks and climbs equal even to that of the scenery. It is well known to all who visit the romantic mountains, lakes and fjords of Mt. Desert that there are at several points quite perfect mirror echoes. Every sound, harsh or musical, is thrown back sharp, distinct, absolutely unaltered and scarcely diminished by the distance. At some points these mirror echoes are multiple and yet clear cut and unaltered. Such echoes are devoid of beauty or of interest in the present connection, except that they may serve sometimes to suggest that others of the prismatic and musical variety may be found in the neighborhood. Often, however, the latter, which are more numerous and yet harder to find, are not associated with any sharp or mirror echo. In the spectral echoes all harshness or mere noise disappears; and only the tones and overtones swell and linger hauntingly. They are purer in musical quality than any notes made by an orchestra in a concert hall; they are only to be compared to the reverberations of such an organ, or of a splendid human voice intoning, in such a vaulted and many columned minster as that of Chartres.

Some of the conditions for such acoustic spectra and the rich chords, which come back from the cliffs, when a scale of notes or a bar is shouted at them, seem to be a wall not quite at right angles, very rough and broken, sometimes with several distinct cliffs. Trees are generally present on the talus slopes below the cliffs, and even in crevices and on ledges between the bluffs; but I am doubtful of their playing any considerable part in sorting out the tones and

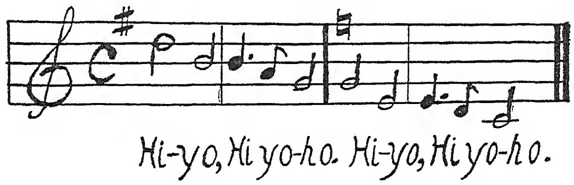
suppressing mere noises. Chiefly it seems to be the direction in which the walls run which acts on the mixed sounds as a prism does on the mixed waves of light; the roughness of the cliffs which acts acoustically as a Rowland grating does optically; and the super-position of several mirror echoes which gives a result analogous to that of a Michelson interferometer.

So far as I am aware, no one has reported these spectral or analyzed echoes as occurring on Mt. Desert, and it is certainly not generally known that the precipitous granite hills carved out by the glaciers in this region are peculiarly rich in these beautiful acoustic properties. They are much more numerous there and easier to elicit than in any other region with which I am acquainted. On the western side of the island I have found only a few spots with spectral echoes, although echoes of the ordinary or mirror type are perfect in at least two places on that side. On the cliff in Somes Sound a very sharply defined mirror echo is well known, but very little prismatic effect is obtainable. At Echo Lake there is also a well-known mirror echo; and there it is only necessary to go a few rods southward from the focus of the mirror echo, in order to obtain a fine spectral effect.

On the eastern half of the island there are no such sharp mirror echoes as those on the western side, for there are fewer smooth, vertical and isolated walls. There are, however, several splendid spectral echoes. The first to be found is on the trail up Jordan Mountain from Asticou, about two thirds of the way up. It comes across a gorge between two ridges. Even finer spectral echoes are obtainable at several places along the upper part of the cliff trail on the eastern face of Jordan Mountain, reflected from Pemetic and the Bubbles. But perhaps the best of all are those on the "goat trail" down the side of Pemetic Mountain to Jordan Pond. Sounds from there are reflected from the broken eastern face of Jordan Mountain and from the Bubbles. These spectral echoes are multiple, a succession of two or three distinct and separate returns.

In calling musical echoes it is best, in my opinion, to sing or rather shout a few successive notes, either a scale or arpeggio. Best of all is a bar of five notes which are associated with the "fire motif" in Wagner's opera of "Die Walküre."

Of course a considerable volume of sound helps; but it is not necessary to strain an ordinary voice; for distinct and repeated returns may be obtained even by a woman's voice. If a man's voice has in it any musical quality at all, the acoustic prism or grating picks out the harmonious elements and suppresses all mere noise. Thus a rather harshly shouted succession of notes comes back rich, sweet and full, again and again, and finally faint and far, but still clear, as if it were the voice of some elf of the mountains way up among the crags.



I can not resist repeating some of the lines of Emerson from the passage which Professor Forbes quotes at greater length. No scientific description could be truer, for the sounds even of a voice of little natural musical quality, as he says:

Softened are above their will,
Take tones from groves they wandered through
Or flutes which passing angels blew.
All grating discords melt,
No dissonant note is dealt,
And though thy voice be shrill
Like rasping file on steel,
Such is the temper of the air,
Echo waits with art and care,
And will the faults of song repair.

* * * *

The artful air will separate
Note by note all sounds that grate,
Smothering in her ample breast
All but godlike words,
Reporting to the happy ear
Only purified accords.

I recommend the search for spectral echoes as a delightful motive for scrambles among these and other hills.

YANDELL HENDERSON
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RECENT CHANGES IN THE PLATEAU REGION

THE Plateau region, as used in this paper, refers to the plateau south and east of the Colorado River, extending eastward to the Rio Grande country of New Mexico and southward over the highlands of both New Mexico and Arizona to the Mexican line.

A close observation shows that a deep cutting began in this region some time in the early Pleistocene and continued uninterrupted till probably in the late Quaternary (Recent), when the incising process was arrested. Then there set in a refilling of the valleys which continued till our own time. And the valleys are now incising themselves again at a rapid rate.

Concerning the filling of the valleys, Dutton, who examined the region with Powell, 1878–1880, says:[1]

[1] Dutton, C. F., "Tertiary history of the Grand Canyon districts," U. S. Geol. Sur. Mon. 2, pp. 228, 229; 1882.

> Most of those lateral canyons . . . are slowly filling up with alluvium at the present time, but very plainly they were much deeper at no remote epoch in the past. The lower talus in some of them is completely buried, and the alluvium mounts on the breasts of perpendicular scarps. In some cases a smooth floor of alluvium extends from side to side of what was originally a canyon valley.

As an instance, when the first white people came to the Marsh Pass-Laguna Creek country and the Segi Canyon region in the Navajo country, 174 miles northeast of Flagstaff, Arizona, there was no Laguna Creek. The valley and canyon floors were a vast plain, dotted with lakes and swamps. A U. S. topographic map made of the region in 1881 shows no stream leading out of it. Hunting parties frequented the region to kill ducks in the swamps and marshes; and the government road led through the pass over the marshy flats, hence the name "Marsh Pass." Then Laguna Creek began to cut back from Chinle Creek thirty miles to the eastward. Year by year it extended its possessions till to-day it ramifies every part of the inner valley and the Segi canyons, has drained all the ancient pools, swamps and lakes, and has the whole country cut up with a maze of lateral, straight-walled chasms fifty feet or more in depth. And the Tokas Jay, the stream leading northward up the valley along the road to Marsh Pass from Moenkopi wash, and Pueblo Colorado wash at Ganado, 45 miles west of Fort Defiance, Arizona, will cut up those valleys and destroy their lakes and pools, as Laguna Creek has done in the Kayenta region, unless man brings about some means to stop their devastating process.

Many people, including the geologist, Herbert E. Gregory,[2] believe that the aggrading of the valley floors of this region was due solely to climatic changes—little rainfall and the action of the wind. They also believe that the cutting of the present valley fillings is due in the main to the overgrazing of the region and the making of paths and roads.

The factors above mentioned no doubt aided in building up or degrading the fluviatile valley floors; but it would seem to the writer that possibly the main agent in causing the aggrading of the valley floors was man.

The Hopis (and occasionally the Navajos) of to-day build dams and ditches to direct the flood waters of the respective washes and also to prevent canyon cutting; also a series of check dams are often built along moderate slopes and along small washes to retard the run-off and to impound water for stock and house use. Occasionally the valley sides are terraced to prevent arroyo cutting. The dams, which are about five feet in height, are of earth and consequently have to be made annually. Though requiring a great amount of work, through this impounding of water and diverting of washes, water is furnished for much of their stock, and over 20,000 acres of land is irrigated.

In the long ago, when this region was densely populated, as has been shown by Messrs. Kidder and Guernsey,[3] and by the writer,[4] each little wash and flat had its village, and the water was carefully husbanded in the irrigation of the necessary fields and was impounded by reservoirs and check dams for village use. At the present time more than 90 per cent. of the flood waters escape down the washes. The escape of the flood water then was nil, and probably this condition existed for thousands of years. As evidence that such damming and diverting of water was practiced by the ancients, fragments of check dams of loosely piled stone arranged on sloping rock benches and on the terraced floors of the washes may be seen near many of the ruins of the ancient cliff houses and villages of this region (and these villages and cliff houses were numerous).

The triangular Laguna Creek area between Marsh Pass and Church Rock, eighteen miles in length and seven miles across its base at Church Rock, contains 202 ruins of villages, and the Cornfields region from Ganado southward down Pueblo Colorado wash valley to Sunrise Springs, a distance of seventeen miles, contains 173 ruins. This reduced the run-off to the minimum. As a result the *débris* brought down from the mesas by washes was left on the fields and deposited as fans over the valley flats. As no water ran down the main channels, they gradually filled up. Wind action no doubt played a part in filling up the valleys. However, there is no evidence that sand dunes were the main factors in closing any part of the streams of the region. On the contrary, their banks are clays, pond deposits (including layers filled with snail shells) and wash material. In time the drainage became wholly blocked, not because of a lack of rain sufficient to carry off the *débris,* but *because man used the accumulating waters for his own use.* Outrushing washes, descending from the higher areas, also now and then pushed their dry fans farther and farther across the region till the valleys were wholly dammed and the excess water impounded in shallow lakes. Then by this same process the valley flats were gradually aggraded. That this valley filling occurred since the coming of the villagers is evidenced by the presence of pottery, corn cobs, kitchen refuse and occa-

[2] "Water resources of the Navajo country," U. S. Geol. Sur., Water Supply Paper 380, 1916, p. 100.

[3] Kidder, Alfred Vincent, and Guernsey, Samuel J., "Archeological explorations in northeastern Arizona," Bulletin 65, Bureau of American Ethnology, Washington, 1919.

[4] Reagan, Albert B., "Archeology of the Tuba-Kayenta region in Arizona," Trans. Kan. Acad. Sci., Vol. 30.

sional walls of rooms, buried beneath the filling of the terraces, now exposed in the banks of the present streams. The villagers and cliff people then left the region. The region then remained in a state of equilibrium as they left it for hundreds of years, except that the ponded areas probably increased in depth and the fluvial, dry ridges increased in height, for, as is well known, an established condition will remain till some excessive influence (change) overwhelms it. Thus the valley aggrading continued. Then the Navajo came with his stock and the white man with his roads and trails. The grass and herbage was short-cropped, and trails led down the valleys and from the mesas and mountains. Moreover, but little or no water was used for irrigation. As a consequence of these changes the rainfall rushed down the almost bare slopes, collected in the trails and rushed on toward a central point in the respective valley. Along these paths (and roads) canyons were cut and permanent channels formed. By these the waters collected in the central area in sufficient volume to commence cutting a channel to a master stream; and this cutting will continue till man again arrests its progress.

In summary, the intensive farming and use of water for irrigation and the reservoiring of every side mountain canyon for village use and for irrigation in the days when the villagers swarmed the land caused the master streams to be filled up and the valleys to be aggraded, a process which continued even to our own time. Professor Gregory says, as we have seen, that a lack of rainfall to a certain limit would cause the valleys to be aggraded. *If, on the other hand, man used the water to that same limit, the aggrading result would be the same.* And the evidence that the cliff-village dwellers did so is unquestionable. Every side wash, canyon and flat had its village or villages, its dams, ditches and reservoirs, as is readily seen by examining the region. The aggrading of the valley floors and the often laking of same was evidently directly due to man's work. This is attested by the fact (1) that the flora and fauna are now the same as when the cliff dwellers lived there, with the exception of what the white man has destroyed since his coming; and (2) that in the sections that have little rainfall now but few villages in the open or in the canyons are found, and these are often small, whether open or cliff ruins, indicating that they were merely hunting-season or summer-outing villages. The evidence adduced is that the climate is the same now as when the villagers lived here. (Of the known 73 species of the living fauna of the region, including birds, 51 of the species have been found in the village-cliff ruins, and probably 40 per cent. of the characteristic living flora of to-day has likewise been found in the *débris* left by those ancient peoples.) Moreover, then and up to thirty years ago all the precipitation was kept in the region, and the rainfall of to-day would sustain a large population if it was all used for crop production, as it was then, provided the people had as few wants as those villagers had and also made use of all the herbs of the fields and mountain slopes as even the Hopis do, it being said that they now use 146 plants. Moreover, the evidence on the whole must lead to the conclusion that the intensive use of the water by the natives was a cause of the aggrading of the valleys. The evidence also further shows that when the conditions of the region were most favorable for the habitation of the villagers, they left it.

The writer also wishes to add this factor to the cause of the aggrading mentioned above. When the villagers dominated the region, which was for hundreds of years, they had no domesticated animals. Moreover, the wild animals of the country were killed off for food and clothing by them. This left nothing to prevent a rather rank vegetation to dominate any part of the region not under cultivation. Grass, weeds, shrubbery and timber was evidently more abundant. As is recognized and advocated by all advocates of keeping up reserving our forests, this prevented a rapid run-off of the water of the summer rains and winter snows, and this, too, aided materially in the valley building which we have been considering. Then the overgrazing in our own time is bringing about a degrading of the same region.

This brings out the fact that a change of elevation in high and moderately elevated regions is not necessary for the streams to begin to incise their channels; but this incising of the streams may be brought about by an overgrazing (deforesting) of the region —by domestic stock of civilized man or by the increasing and incoming of herds of wild beasts. This probably accounts for certain cutting of streams in the past. Then when the beasts had destroyed the vegetation by grazing and had either left the region or starved to death in it, the vegetation sprang up again and the streams began again to aggrade their valley floors. This overgrazing of regions may also account for the extermination of many species in the past. When the edible plants became so destroyed that the beasts could not be properly nourished, they would become diseased and finally exterminated, provided they did not migrate to some other more favorable region, which was not always possible. The aggrading and degrading of valleys and the coming and going (dying) of hordes of herbivorous beasts seem to have a direct relation to each other, but in reverse order. The streams aggraded their valleys when herbivorous animals are few in number, and degrade their valleys when hordes of them are consuming the vegetation.

Albert B. Reagan

Cornfields, Ganado, Arizona

SCIENTIFIC EVENTS

THE IMPERIAL FORESTRY INSTITUTE AT OXFORD

THE current number of the *Empire Forestry Journal*, issued by the Empire Forestry Association, Imperial Institute, South Kensington, deals with the establishment at Oxford of an institute which will be known as the Imperial Forestry Institute. According to an abstract in the London *Times*, the question of establishing a central training institution was first discussed by the British Empire Forestry Conference in 1920. This conference felt that, owing to lack of funds and dissipation of effort, training in the higher branches of forestry for the needs of the Empire was nowhere so complete or efficient as was desirable, and therefore recommended the establishment in the United Kingdom of one institution which should undertake the higher training of forest officers, and should also be a center for research into the formation, tending and protection of forests. A committee was appointed to make recommendations regarding the location and organization of such an institution, but it was not until last year that the proposals were endorsed by the Imperial Economic Conference in London, and arrangements made for starting the institute in October, 1924.

The Imperial Forestry Institute will be a university institution, the professor of forestry being its director. It will be under the control of a board of governors, representing the university and government departments concerned, under the chairmanship of Lord Clinton, a forestry commissioner. The educational work of the institute will comprise (1) post-graduate training of probationers for the forest services and of other qualified persons; (2) training of research officers in special subjects, and (3) provision of courses for selected officers already serving.

It is intended that the institute shall maintain close touch with the various forestry training centers throughout the Empire. Thus, in the case of overseas training centers which have no direct means of giving practical instruction in the latest systems of management as practised on the Continent of Europe, it will be one of the functions of the institute to arrange for such practical instruction to be given by members of its own staff to students who have already completed their general course of training at their own universities or colleges. If, in any particular case, it can not undertake to give direct instruction, the institute may arrange that this should be given at some other place.

Although the institute is intended primarily to serve the needs of forestry in the British Empire, it will be open to qualified students of any nationality, provided that there is sufficient accommodation. Nor is it by any means intended that it should cater only for the requirements of state forest services; the institute should, it is believed, be of special value in providing timber and wood-pulp firms with fully-trained employees. Students admitted to the institute may, in fact, be included under any of the following categories:

(*a*) Those possessing a degree in forestry, or a diploma or equivalent certificate of having satisfactorily completed an approved course of training in forestry, who have been selected as probationers for the higher branch of some forest service.

(*b*) Graduates with honors in science, who desire to become specialists in some branch of work connected with forestry.

(*c*) Forest officers deputed to attend courses with the view of bringing their professional knowledge up to date.

(*d*) Students of approved qualifications not included in the first three categories who are admitted on the recommendation of overseas governments.

(*e*) Students with a university training in forestry who may wish to attend the institute on their own account and at their own expense.

The courses of study will normally extend over one academic year. Temporary accommodation for the institute has been arranged, but a more suitable site and larger buildings will be necessary. The university has undertaken to contribute a sum not exceeding £300 a year to the Department of Forestry, in addition to its present contribution. The selection of Oxford has caused considerable misgiving at the other universities in Great Britain which confer degrees in forestry; but the governing council of the Forestry Association are confident that all concerned will unite to make the institute a complete success.

ITHACA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE sixty-eighth general meeting of the American Chemical Society was held at Ithaca, N. Y., from Monday, September 8, to Saturday, September 13, inclusive. The council meeting was held on the afternoon of the eighth; the general meeting on Tuesday morning, the ninth; the special meeting descriptive of the new Baker Laboratory on the afternoon of the ninth; general divisional meetings on Wednesday morning, the tenth; and special divisional meetings on Wednesday afternoon and Thursday.

On Tuesday evening the members enjoyed an evening of entertainment with a program chiefly drawn from local talent. It was, however, a program of unusual merit and high character.

On Tuesday morning the society was welcomed by President Livingston Farrand, and, after a short response by President Baekeland, the following general addresses were delivered: "Chemistry and civiliza-

tion," by Sir Max Muspratt, United Alkali Company, Liverpool, England; "Serum Globulins," by Professor S. P. L. Sorenson, Carlsberg Laboratory, Copenhagen, Denmark; "The chemistry of the tri-nitrotoluenes," by Sir Robert Robertson, president of the chemical section of the British Association for the Advancement of Science.

On Wednesday night President Baekeland delivered his presidential address, entitled, "Prospects and retrospects." President Farrand was to have spoken on "Science and the nation's wealth," but was confined to bed by illness. Accordingly, the address had to be omitted, much to the regret of all members attending the meeting.

On Friday afternoon some three hundred members took a boat ride to Taughannock Falls and later enjoyed a dinner and dance at Glenwood, Ithaca's most delightful suburban resort.

Friday being Defense Day, President Baekeland sent the following telegram to Major General Amos A. Fries:

> As President of the American Chemical Society, and on behalf of its 15,000 members, I extend to the nation our hearty support of Defense Day and the principles it represents and wish you continuous success in your efforts in the application of chemistry to the country's welfare.

The four general programs by divisions on Wednesday morning were under the auspices of the Division of Chemical Education, Division of Physical and Inorganic Chemistry, Division of Industrial and Engineering Chemistry and the Divisions of Sugar and Cellulose, jointly.

All divisions and sections met.

One thousand and eighty-seven members and guests registered, and 265 papers were presented to the various meetings.

The divisions elected officers as follows:

Agricultural and Food Chemistry: Chairman, C. H. Bailey; Vice-chairman, E. F. Kohman; Secretary, C. S. Brinton; Executive Committee, the chairman, vice-chairman and secretary.

Biological Chemistry: Chairman, R. Adams Dutcher; Secretary, R. J. Anderson; Executive Committee, H. Steenbock, A. D. Holmes, W. R. Bloor, Arthur Knudson, A. P. Lothrop.

Cellulose Chemistry: Chairman, H. LeB. Gray; Vice-chairman, L. E. Wise; Secretary, L. F. Hawley; Executive Committee, Harold Hibbert, G. J. Esselen, Jr.

Chemical Education: Chairman, W. A. Noyes; Vice-chairman, T. G. Thompson; Secretary, B. S. Hopkins; Treasurer and Business Manager, E. M. Billings; Executive Committee, J. D. Hildebrand, H. A. Carpenter, H. R. Smith.

Dye Chemistry: Chairman, R. Norris Shreve; Vice-chairman, J. E. Ambler; Secretary-treasurer, O. E. Roberts, Jr.; Executive Committee, the chairman, vice-chairman, secretary-treasurer, L. H. Cone, I. W. Fay.

Fertilizer Chemistry: Chairman, F. B. Carpenter; Secretary, H. C. Moore.

Industrial and Engineering Chemistry: Chairman, W. A. Peters, Jr.; Vice-chairman, W. H. McAdams; Secretary-Treasurer, E. M. Billings; Executive Committee, C. E. Coates, W. K. Lewis, S. W. Parr, E. R. Weidlein, Robert McKay.

Leather and Gelatin Chemistry: Chairman, John Arthur Wilson; Vice-chairman, L. R. Ferguson; Secretary, Arthur W. Thomas; Executive Committee, J. H. Cohen, W. H. Irwin.

Medicinal Products: Chairman, E. H. Volwiler; Secretary-Treasurer, H. A. Shonle; Executive Committee, O. Kamm, E. B. Carter.

Organic Chemistry: Chairman, J. A. Nieuwland; Secretary, Frank Whitmore.

Petroleum Chemistry: Chairman, R. R. Matthews; Vice-chairman, R. E. Wilson; Secretary, G. A. Burrell; Executive Committee, W. F. Faragher, C. O. Johns.

Physical and Inorganic Chemistry: Chairman, Arthur E. Hill; Vice-chairman, Harry B. Weiser; Secretary, G. S. Forbes; Executive Committee, Graham Edgar, James Kendall, W. C. Bray.

Rubber Chemistry: Chairman, C. R. Boggs; Vice-chairman, J. M. Bierer; Secretary, A. H. Smith; Executive Committee, E. H. Grafton, E. B. Spear, Frank Kovacs, L. B. Sebrell, A. A. Somerville.

Sugar Chemistry: Chairman, W. B. Newkirk; Vice-chairman, H. W. Dahlberg; Secretary-Treasurer, Frederick Bates; Executive Committee, C. E. Coates, Chairman, W. D. Horne, S. J. Osborn, H. Z. E. Perkins, J. R. Withrow, H. E. Zitkowski.

Water, Sewage and Sanitation: Chairman, F. W. Mohlman; Vice-chairman, T. G. Thompson; Secretary (to be elected later); Trustees, W. F. Langlier, A. M. Buswell.

CHARLES L. PARSONS,
Secretary

MEETING OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

MEMBERS of the American Institute of Mining and Metallurgical Engineers will make a ten-day inspection of the mining and metallurgical industries of the south, leaving Washington, D. C., on October 7, and stopping at Birmingham, Ala., on October 13, for the 130th meeting of the institute, which will last three days.

England will send as its representative, to accompany the American engineers, Sir William Ellis, president of the British Iron and Steel Institute, who will arrive in this country early in October. Sir William's presence is the response of British engineers to the action of the American engineers in commissioning Charles F. Rand, of New York, head of the Engineer-

ing Foundation, to a recent meeting of the British Institute in London.

Expressing the development of a conscious policy of closer relations with the engineers of other countries, the American Institute, through its president, William Kelly, of Iron Mountain, Mich., has sent a message to the British engineers expressing appreciation of their generosity "in placing the results of their scientific labors at the disposal of the entire world."

The mining engineers will journey from Washington by special train, stopping at the Caves in the Shenandoah Valley, the Pocahontas coal fields, the Mascot zinc mines, the Tennessee marble quarries, Copperhill, Ducktown and the battlefields of Chattanooga. October 13, 14 and 15 will be spent at Birmingham. The return to Washington will be via Sheffield, Ala., where the Wilson Dam and power plant are nearing completion.

Papers to be presented at the Birmingham technical sessions will deal chiefly with the industries centered around the points to be visited. Speakers and their topics will include: Wilbur A. Nelson, Nashville, "Geology of the Mascot (Tennessee) zinc deposits" and "Geology of the east Tennessee copper deposits"; Robert Ammon, New York, "Milling practice at Mascot"; H. A. Coy, Brooklyn, N. Y., and J. A. Nobel, Mascot, "Mining methods at Mascot"; Milton H. Fies, Birmingham, "Alabama coal mining practices"; Henry S. Geismer, Birmingham, "Blast furnace practice in Alabama"; T. L. Joseph, Minneapolis, "Effect of sulphur in blast furnace practice"; Theodore Swann, Birmingham, "Production of ferro phosphorus in the electric furnace"; Richard Moldenke, Watchung, N. J., "Manufacture of cast iron pipe in the south"; James Bowron, Birmingham, "The Alabama steel industry."

THE CENTENARY CELEBRATION OF THE FRANKLIN INSTITUTE

The centenary celebration of the founding of the Franklin Institute and the inauguration exercises of the Bartol Research Foundation were held in Philadelphia on September 17, 18 and 19 in accordance with the program that has been printed in Science. Dr. William C. L. Eglin, the president of the institute, presided, and the arrangements were in charge of Professor Gellert Alleman, vice-president of the institute and chairman of the executive committee.

At the first general meeting on the morning of September 17, the delegates and guests assembled at the Hall of the Franklin Institute and were welcomed at the Walnut Street Theater by the mayor of Philadelphia. Addresses were made by President Eglin and Dr. Elihu Thomson, honorary chairman of the centenary celebration, who reviewed the history of the institute, in connection with which some of his earlier scientific work had been done. At an open meeting on the evening of September 18, Professor Sir Ernest Rutherford, of the University of Cambridge, gave an address on "The natural and artificial disintegration of elements."

On the morning of September 19, a tablet was unveiled at the Bartol Research Foundation in its temporary buildings facing the Academy of Natural Sciences. Mr. C. C. Tutwiler, vice-president of the institute, presided and made an address, and the tablet was unveiled by a grandniece of the donor, who bequeathed to the institute a sum in excess of a million dollars for research in fundamental problems of physical science and for investigating scientific problems that may arise in industry. Following the unveiling of the tablet a general session was held at the Academy of Natural Sciences with addresses by Dr. Arthur D. Little, of Cambridge, and Dr. D. S. Jacobus, of New York.

There were daily luncheons at the Bellevue-Stratford, a garden party on the afternoon of September 18, and a banquet for delegates and guests on the evening of September 19. Among the speakers at the banquet were Sir Ernest Rutherford for the British Empire, Professor Charles Fabry for France, and Professor F. Haber for Germany. Greetings were presented from a large number of representatives of universities and colleges and of learned and professional societies.

At the sectional meetings held on September 17, 18 and 19, there was a distinguished list of speakers, which included Professor Joseph S. Ames, Professor Wilder D. Bancroft, Professor Sir William H. Bragg, Professor William L. Bragg, Professor P. W. Bridgeman, General John J. Carty, Professor E. G. Coker, Dr. William D. Coolidge, Director Arthur L. Day, Professor F. G. Donnan, Dr. William Leroy Emmet, Professor Charles Fabry, Professor F. Haber, Professor W. J. Humphreys, Brigadier-General Edgar Jadwin, Dr. George L. Kelley, Professor A. E. Kennelly, Dean Dexter S. Kimball, Dr. Irving Langmuir, Professor C. H. Mathewson, Dr. C. E. K. Mees, Professor Charles E. Mendenhall, Professor A. A. Michelson, Professor Dayton C. Miller, Professor W. Lash Miller, Dr. Ralph Modjeski, Mr. Daniel E. Moran, Sir Charles Algernon Parsons, Major-General Mason M. Patrick, Dean Harold Pender, Mr. F. W. Peek, Director Charles L. Reese, Dr. E. W. Rice, Provost Emeritus Edgar F. Smith, Dr. Frank J. Sprague, Major-General George O. Squier, Professor Julius Stieglitz, Professor Bradley Stoughton, Professor W. F. G. Swann, Professor John Sealy Edward Townsend, Professor Augustus Trowbridge, Major-General C. C. Williams and Professor Pieter Zeeman.

SCIENTIFIC NOTES AND NEWS

THE University of Pennsylvania held a special convocation on the occasion of the Franklin Institute centenary, when President J. H. Penniman conferred the honorary degree of doctor of science on the following delegates: Sir William Henry Bragg, London; Dr. William Charles Lawson Eglin, chief engineer of the Philadelphia Electric Company and president of the Franklin Institute; Dr. Charles Fabry, Paris; Sir Charles Algernon Parsons, British engineer; Dr. Edwin Wilbur Rice, Jr., honorary chairman, of the General Electric Company, and Dr. Pieter Zeeman, Amsterdam.

OFFICIAL representatives of the United States have been appointed by the Department of State for the third Pan-American Congress at Lima, Peru, from December 20 to January 6, as follows: Dr. Leo S. Rowe, president of the American Academy of Political and Social Sciences, chairman; Dr. Albert Sauveur, professor of metallurgy at Harvard University; Professor Marshall H. Saville, Museum of the American Indian, Heye Foundation, New York; Dr. A. A. Michelson, president of the National Academy of Sciences; A. W. Whitney, chairman, American Engineering Standards Committee, New York; Dr. John D. Long, assistant surgeon general, United States Public Health Service; Dr. Vernon Kellogg, secretary of the National Research Council, Washington, D. C.; James Brown Scott, president of the American Institute of International Law, Washington, D. C.; Dr. Samuel McCune Lindsay, professor of social legislation, Columbia University; Dr. Rufus B. Von Kleinsmid, president of the University of Southern California, Los Angeles, Calif.

DR. ROBERT J. WILSON, director of the bureau of hospitals, Department of Health, New York City, was presented with an illuminated autograph token of esteem by the employees of that bureau and the bureau of laboratories, on his recent retirement as director following twenty-eight years of service.

PROFESSOR W. E. S. TURNER, secretary of the Society of Glass Technology, Sheffield, England, was the guest of honor at a dinner given by the members of the Pittsburgh section of the American Ceramic Society at the University Club on September 4.

DR. SAMUEL BENJAMIN JONES, a West Indian, who received his medical education in the United States, has been awarded by King George the order of Member of the British Empire in recognition of meritorious services rendered in combating a smallpox epidemic in the British West Indies in 1923.

DR. E. O. HULBURT, formerly associate professor of physics at the University of Iowa, has been appointed superintendent of the division of heat and light of the Naval Research Laboratory, Washington, D. C.

ELWOOD MEAD, professor of rural institutions at the University of California, has been appointed commissioner of the Bureau of Reclamation, U. S. Department of the Interior.

H. G. SCHURECHT, ceramic engineer at the Mellon Institute, Pittsburgh, has accepted a position with the Bureau of Standards.

GEORGE H. CONANT, formerly of the department of botany at the University of Wisconsin, has resigned to take charge of the division of botany of the General Biological Supply House, Chicago, and Dr. D. L. Gamble, assistant professor of zoology at Cornell University, has resigned to take charge of the division of zoology.

DR. THURMAN B. RICE has been appointed director of the laboratory of bacteriology and hygiene of the state board of health of Indiana, to succeed Dr. Alfred G. Long.

THE following appointments have been made by the Eastman Kodak Co., Rochester, N. Y.: Dr. R. H. Lambert, Ph.D. (Mass. Institute of Technology), in the research laboratory; Dr. Cyril J. Staud, Ph.D. (Mass. Institute of Technology), in the organic research department; Dr. Otto Sandvik, Ph.D. (Northwestern University), in the department of physics. Mr. Merrell Seymour has accepted a position in the photographic department of the research laboratory.

DR. WILHELM DEECKE, professor of geology and paleontology and director of the Geological Institute of the University of Freiburg, has resigned his position as director of the Geological Survey of Baden.

DR. JOHN K. SMALL, head curator of the museums of the New York Botanical Garden, returned on July 30 after a three weeks' visit to Florida, mainly in search of irises (with special reference to finding the fruits), papaws and plants of other critical genera and species.

N. E. HANSEN, agricultural explorer of South Dakota, is leaving on his sixth trip to Siberia in search of fruits and plants adaptable to the climate of the Northwest.

DR. HERBERT J. WEBBER, professor of subtropical horticulture and director of the Citrus Experiment Station of the University of California, has gone to South Africa, where he will spend the next year under a commission from the government of the Union of South Africa to study and prepare a report on the citrus and cotton growing industries of that country. His headquarters will be at the Department of Agriculture, Pretoria, Transvaal. Before leaving Europe

he will make a short study of orange-growing methods in Spain.

Dr. B. E. Lischer, professor of orthodontics at the Washington University Dental School, gave a series of lectures on orthodontics at the University of California from August 25 to September 4.

A portrait bust in bronze of Louis Pasteur was dedicated on September 16 at the American Institute of Baking. The bust was presented by Helge Jacobsen, director of Carlsberg Glyptotek; Vagn Jacobsen, director of Carlsberg Brewery, and the Carlsberg Fund, Poul C. Poulsen, director, Copenhagen, Denmark.

Dr. John Martin Schaeberle, formerly astronomer at the Lick Observatory, has died at the age of seventy-one years.

Dr. Charles W. Moulton, head of the department of chemistry at Vassar College, died on September 13, aged sixty-five years.

Dr. Albert Haworth, recently appointed lecturer in pathology at the University of Leeds, England, died on September 8, at the age of thirty-six years.

Dr. Alfred Bergeat, professor of mineralogy and director of the Mineralogical Institute of the University of Kiel, has died, aged fifty-eight years.

Dr. Koloman v. Szily, emeritus professor of physics at the Budapest Polytechnic School and formerly the general secretary of the Hungarian Academy of Sciences, has died at the age of eighty-six years.

The thirty-fifth annual general meeting of the Institution of Mining Engineers of England will be held at the Conference Halls of the British Empire Exhibition on Thursday and Friday, October 2 and 3. Sir John Cadman will relinquish his third term of office as president on October 2, when he will be succeeded by Dr. J. S. Haldane, director of the Mining Research Laboratory and honorary professor in the University of Birmingham.

The zoological department of the Vienna Museum of Natural History opened recently a collection of insects having a bearing on medicine, according to the Vienna correspondent of the *Journal* of the American Medical Association. The whole exhibit, divided into six groups, shows which of these organisms exerts a disease-producing action on human beings or animals (1) by means of the secretions of its glands, (2) by means of hairs, (3) by poisonous appendages, (4) by sucking the blood, (5) by parasitism, or (6) by transmitting disease germs. The entire life cycle of these organisms, as far as it is known, is shown in a series of specimens arranged so as to reproduce the natural conditions, and short but concise explanations are placed in each receptacle. The organisms that are too small to be well visible with the naked eye are represented in colored photographic enlargements. Once a week expert guidance is provided. The entire collection comprises about 6,000 specimens.

The Pasteur Institute has set up in the island of Los, near Konakri, in French Guinea, a "farm" for the breeding and preservation of apes and monkeys required for medical experimental purposes. This is a large, well-watered, woody fertile tract of land near a forest inhabited by chimpanzees and several species of monkeys. A director has been appointed, and the necessary outbuildings constructed. These include accommodation for sick animals.

In order to determine the suitability of foreign trees for introduction into this country, arboretums in which groups of such "immigrant" species can be tried out are being established by the United States Forest Service in several of the forest regions. At Wind River 60 miles from Portland an arboretum of this sort has now some seventy-five different alien species of trees growing in small-sized groups or clumps. These trees are carefully watched by members of the Pacific Northwest Forest Experiment Station, which has a branch station at Wind River, and their growth and general development and ability to become acclimatized are studied. Local records of climate and soil conditions are also maintained.

UNIVERSITY AND EDUCATIONAL NOTES

The Tulane University of Louisiana School of Medicine, New Orleans, has announced plans for the establishment of a chair of tropical medicine, made possible by a bequest of $60,000 from William E. Vincent.

In addition to the sum of $110,000 bequeathed to the Western University Faculty of Medicine, Ontario, by Dr. Friend R. Eccles, $200,000 will become available after the lifetime of two relatives.

An anonymous donor has given funds to the University of Chicago for the maintenance of a research fellowship in preventive medicine for two years.

New appointments at the Johns Hopkins University include Dr. F. O. Rice, formerly of the University of Liverpool, in physical organic chemistry, and Dr. F. Russell Bichowski, research associate at the University of California, in thermodynamics.

At the University of Virginia the following appointments have been made: Dr. Bruce D. Reynolds, Ph.D. (Johns Hopkins, '24), assistant professor of zoology, Dr. Arthur F. Benton, national research fellow at the California Institute of Technology, assistant professor of chemistry, and Dr. A. A. Pegau,

Ph.D. (Cornell), acting assistant professor of geology. Resignations include Dr. Graham Edgar, professor of chemistry, Dr. J. T. Lonsdale, assistant professor of geology, Dr. W. S. Keister, assistant professor of public health, and Dr. B. B. Hershenson, assistant professor of physiology and biochemistry.

DR. NICHOLAS M. ALTER, instructor in internal medicine at the University of Michigan Medical School, Ann Arbor, has been appointed professor of pathology at the University of Colorado School of Medicine, Denver.

THE vacancy in the University of Texas College of Pharmacy, caused by the death of Dr. Raoul R. D. Cline, has been filled by the appointment of William F. Gidley, professor of pharmacy at Purdue University.

DR. GEORGE N. BAUER, formerly professor of mathematics at the University of Minnesota, and recently president of a Minneapolis bank, has been appointed associate professor of mathematics at the University of New Hampshire.

DR. RAYMOND O. FILTER, assistant professor of psychology at the University of Minnesota, and Dr. Homer B. Reed, professor of psychology and education at Grinnell College, have each been appointed to an assistant professorship of psychology at the University of Pittsburgh.

AT Pomona College, Dr. Paul Atwood Harvey has been appointed assistant professor of botany, and Francis G. Gilchrist, instructor in zoology.

DR. CHESTER HAMLIN WERKMAN, research bacteriologist at Iowa State College, has been appointed assistant professor of microbiology at Massachusetts Agricultural College, to succeed Dr. Itano, who has returned to Japan.

DR. D. P. D. WILKIE, lecturer in clinical surgery, has been appointed to the chair of surgery at the University of Edinburgh for a period of ten years.

DR. JULIUS WATJEN, prosector at the hospital of Barmen, has been appointed professor of pathology and director of the laboratories of the Pathological Institute of the University of Berlin.

DISCUSSION AND CORRESPONDENCE

PLANT CLASSIFICATION IN ELEMENTARY BOTANICAL TEXTS

IN a recent number of SCIENCE[1] Professor D. H. Campbell takes to task the authors of some of our current botanical texts, citing in particular a recent book by the present writer, for their conservatism in still accepting the same primary divisions of the plant kingdom which were in use fifty years ago, and asks whether this is due to ignorance or merely to indifference. In view of the fact that this system of classification (which divides the plant kingdom into four main groups, the Thallophytes, Bryophytes, Pteridophytes and Spermatophytes) is employed in most of the texts in common use to-day, one is tempted to suspect that there may be other reasons for its persistence than those which Professor Campbell suggests. Two of these reasons the writer desires to mention here.

First, such a method of presenting the plant kingdom to an elementary student has important pedagogical advantages. The author of an elementary text must, of course, be cognizant of the results of modern research, but his chief problem is to present these results without overwhelming the beginner by an array of discouraging complexities. It is now clearly recognized, for example, that the so-called Thallophytes are a very heterogeneous assemblage of plants and include a large number of diverse groups which represent more or less independent evolutionary lines and may not be closely related to one another. All Thallophytes, however, have certain fundamental characters in common, and stand at an evolutionary level quite distinct from that of the higher groups. The teacher who wishes to acquaint a beginner in botany with the salient features of the plant kingdom as a whole and who is allotted but a short time in which to do so will have the best chance of success if he treats the Thallophytes as a single great, though admittedly heterogeneous, group, emphasizing the resemblances among them rather than the differences, and pointing out the main features whereby they may be distinguished from the other major divisions. Similarly, the Bryophytes, Pteridophytes and Spermatophytes are probably not strictly monophyletic groups, but each nevertheless has certain points in common by which it may be readily distinguished and its position in the plant kingdom fixed.

We may fairly expect the elementary student to become familiar with four major groups, but if we ask him to learn twenty or thirty of these we must plan to devote to this end the bulk of the entire course. Elementary college courses of this type, commonly in vogue half a century ago, no longer meet the need for progressive botanical instruction, and one is inclined to ask whether their occasional survival is the result of conservatism or merely of bad pedagogy. There is a widespread conviction to-day that elementary botany should stress the plant as a living organism rather than simply the product of an evolutionary process, and our major effort must therefore be first to acquaint beginners with the im-

[1] Campbell, D. H., "A question of classification," SCIENCE, 55, 64–65, July 18, 1924.

portant principles of morphology and physiology. The comparatively limited instruction in classification for which the first-year student has opportunity should not primarily aim to teach him phylogeny—the province of more advanced courses—but rather to familiarize him with the main features of the plant kingdom as it now exists, explaining briefly those great steps in evolutionary progress which have brought plants to where they are to-day. Has not an over-emphasis of phylogenetic detail been one of the reasons for the fact that botany to-day fills a much less conspicuous place in college curricula than its intrinsic importance warrants?

Secondly, an elementary text can not well present a given conclusion as fact until it has achieved essentially universal acceptance. Professor Campbell seems to imply that there is agreement as to the main facts of plant relationship; but certainly the conclusions which he cites and assumes to be established with regard to the interrelationships of the so-called embryophytes (Bryophytes, Pteridophytes and Spermatophytes) will by no means find unanimous consent to-day. Most botanists would probably agree that "comparative morphology . . . is the safest clue to relationships," but to base conclusions chiefly upon the structure of the reproductive parts alone, as does Professor Campbell, disregards a very important source of phylogenetic evidence and has often resulted in erroneous conceptions. Much attention, particularly during the past twenty years, has been devoted to another branch of comparative morphology, that which deals with the *vegetative* parts of the plant body, and the modern student of evolution draws his conclusions from *both* these important sources. This broader method of phylogenetic investigation has led to the conception of the plant kingdom as divided into two main groups, the non-vascular plants (Thallophytes and Bryophytes) and the vascular plants (Pteridophytes and Spermatophytes). Certainly between these two major divisions there are such profound differences in structure and function that it is hard to see how a student of evolutionary history can look upon the embryophytes as a very homogeneous group. Surely between mosses and ferns there are such fundamental divergences, if one is willing to consider all the facts, as to warrant the statement made by the writer, which Professor Campbell finds "astonishing," that "in passing from the Bryophytes to the Pteridophytes . . . we cross the widest gap which exists in the continuity of the plant kingdom." For years botanists have been unsuccessfully endeavoring to establish a bridge over this gap, and the author's reference, cited by Professor Campbell, to the most plausible connection (through the Anthocerotales) by no means implies that the gap is other than a very wide one indeed. It is hard to arrive at an estimate of opinion in such a matter as this, but the writer feels confident that a very considerable group of botanists will by no means regard as "an unscientific and outgrown system of classification" that which places liverworts closer to algae than to angiosperms, but will look with suspicion upon any system which is based largely upon the study of only one group of organs.

All these problems of phylogeny look more complex to-day than they did in the first flush of evolutionary enthusiasm, and we realize that their solution must involve a thorough study of anatomy, genetics, paleobotany and other branches of botanical science; and that it can not be based, as so often in the past, merely upon evidence derived from the reproductive structures alone. When facts from all sources have been sifted and botanists have agreed as to the fundamentals of plant classification, then it may be time to present phylogenetic conclusions to freshmen in more dogmatic form; but until that day arrives, there is much to be said in favor of a continued use in our elementary texts of that system which has so long met with favor at the hands of those who are entitled to speak with authority in matters of botanical pedagogy.

EDMUND W. SINNOTT
CONNECTICUT AGRICULTURAL COLLEGE

CHESTNUT TREES SURVIVING BLIGHT

WHEN the chestnut blight (*Endothia parasitica*) became prevalent some years ago it seemed that *Castanea dentata* was doomed. Some suggested that a few resistant trees might remain. The writer has followed the course of the disease with great interest and in recent years his observations made him believe that there was a general lessening in the amount of branches killed per year, while the amount of new growth gradually overbalanced that killed.

Accurate data appeared rather difficult to secure; a measurement of new growth compared with that growth killed during the same year was an obvious index but one requiring considerable labor. Any element of choice should be excluded. From extensive field work in connection with an ecological problem it appeared that any normal area on a given soil type could be taken safely, and in such an area a twenty-meter quadrat was laid out near the middle of a woods. This woods was twenty-year-old second growth, of which the chestnut trees (10 in the quadrat) had been killed and sprouts produced from the base while 14 seedlings had come up and were now from 0.5 to 2.5 m in height. The new growth was measured and found to total 152.60 m. Assuming an average cross-sectional diameter of 0.0035 m for the twigs, the total volume of new twig-tissue produced was $0.001456 m^3$. Measuring the blighted wood in the same

way, it was found to total $0.000079m^3$. It is seen that the amount of new growth is 18 times that killed in the same year.

Not only are saplings showing recovery of growth but older trees as well. Near the writer's home is a fine grove of chestnut trees of 30 to 40 years age; the tops were killed, but the trees are producing new crowns, in some cases recovering half their former height, and are now well set with fruit.

This condition seems common in southeastern Pennsylvania, the trees flourishing more on Chester and Manor soils than on the more sterile Dekalb. It may also be rather a widespread condition, for in passing through the mountains from Harrisburg, Pa., to Buffalo, N. Y., many trees were seen similar to those described. In the Niagara Peninsula of Ontario, especially near St. Catharines, recovery seemed evident.

The improved condition may not be due wholly to greater resistive powers but to a lessened supply of spores, for it is evident that the total production of *Endothia* spores is vastly lessened. The trees have also shown their ability to heal serious cankers, although ultimate recovery is not a necessary consequence.

Those trees, however, which seem most likely to survive and produce seed are in danger of extinction, since the public has been educated to believe that cutting of all chestnut trees from a woodlot is a virtue. Instead living ones should now be preserved. It might prove advisable to locate the best groves and to protect them from cutting and from fire.

Arthur Pierson Kelley

Rutgers University

THE SCIENTIST AND AN INTERNATIONAL LANGUAGE

On reading the article of Dr. R. G. Kent on "The Scientist and an International Language" (Science, No. 1538, June 20) I am particularly glad to hear from a scientist of an English-speaking nation, of the need of an international language for scientists. I fully agree with Dr. Kent in discarding any existing national language as such. I want to call attention to a great handicap on the part of scientists belonging to a nation whose language is not widely intelligible. For instance, in the *Annotations Zoologicae Japonenses* and the *Folia Anatomica,* both published by Japanese biologists, all articles written in Japanese are excluded, and the editors of the Swedish journal *Acta Zoologica* will not accept papers written in Swedish. It is true that for some scientists writing in other languages this may not be felt as a serious handicap. But it remains true that some have the advantage of publishing papers in the mother language, while others have the disadvantage of endeavoring to write in a foreign language.

Dr. Kent proposes the use of Latin as an international auxiliary language among scientists. This was proposed by Zamenhof in his boyhood half a century ago. He soon discarded it, however, because of the extreme difficulty of learning that complicated language, and after years of painstaking effort he finally succeeded in inventing a language, which is now well known by the name of Esperanto.

It is not necessary to explain how easy it is to learn Esperanto, and how freely one can express one's opinion and can describe what he has in mind, even in scientific terms. Every Esperantist will tell you of it. For this reason it would not be desirable to adopt Latin as the spoken language in an international congress. Even if "we give Latin a preferred place in our study of foreign languages" I wonder how many of us would succeed, after a few years' course, in speaking Latin! Esperanto has already experienced a brilliant success in this respect. I believe that it is Esperanto that fulfills our desire of having a neutral auxiliary language in scientific circles.

I may be allowed to add, further, that in Japan some original papers have already appeared in this language in the fields of anatomy, pathology and veterinary science, and that there is a project among a few biologists of publishing an Esperanto bulletin of zoology. This, together with the fact that there exist international as well as local Esperantists' associations in the medical sciences and that several journals are published by them, is sufficient to show the practicability of this language in scientific publications.

Hiroshi Ohshima

Kjusu Imperia Universitato,
Fukuoka, Japanujo

BALL LIGHTNING

In Science for August 8, Mr. W. J. Humphreys, of the U. S. Weather Bureau, requests information as to ball lightning.

Several years ago my home was struck by lightning. A ball of fire seemingly about nine inches in diameter was thrown into the center of my bedroom and exploded with a terrific noise, just as if a bomb had been exploded. Brilliant particles seemed to have been hurled into every direction, but I felt no effect other than that of sound and sight.

The electric wires throughout the house were affected, and there is an inch hole through the plastered wall on the ground floor where an electric spark seems to have found its path between the radiator in the room and the metal support to the water spout on the outside of the building.

I took the matter up with Dr. T. C. Mendenhall, with whom I was associated on the board of trustees of Ohio State University, and on expressing a doubt

as to my observations, I was assured by him that in his study of lightning for many years he had come across similar phenomena and that he felt sure that my observations had been correct.

John Kaiser

Marietta, Ohio

SWARMING OF DESERT MILLIPEDS

A question should be placed with "A note on migration of Myriapoda," in Science for July 25, 1924, regarding the identification of the "black objects" encountered in the desert of New Mexico as centipedes of the genus Scolopendra. Black centipedes are not known, but large black millipeds, commonly referred to the genus Spirostreptus, are widely distributed in the desert regions of western Texas, New Mexico and Arizona. The period of the summer rains is the breeding season of these animals, and in damp weather they often emerge in large numbers from the burrows of the desert rodents, though seldom seen at other times. That the "black objects" were not examined closely is indicated by the statement that "we stopped just long enough to notice that these objects were centipedes."

O. F. Cook

Bureau of Plant Industry,
U. S. Department of Agriculture

SCIENTIFIC BOOKS

The Unstable Child. By Florence Mateer. New York, D. Appleton and Co., 1924, pp. xii + 471.

Dr. Mateer's book is a fairly complete manual for the administration of a psychological clinic, and there has been no book covering this important field as such. Furthermore, it contains the first review of psychometric methods that is at once broad and critical. These features themselves suffice to put it in the "indispensable" class for clinical psychologists for some time to come. The title might denote a book from the more strictly clinical viewpoint, rather less concerned with the administrative and research aspects of the topic. It is by no means devoted to case studies of conduct problems.

There are many useful suggestions on the conduct of psychometric examinations. On this matter the differing accounts of experts probably reflect the methods by which they personally get the best results, and as their personalities differ, so do the methods they sponsor. Dr. Mateer ranges herself with the advocates of year scale rather than point scale principles. A strong case is made out for giving the Binet type of scale according to topical categories, *e.g.*, all the "comprehension" tests together, instead of, for example, by years. Goddard is credited with first appreciating the significance of "scatter," which is apparently quite correct, though the date of the reference cited, 1921, is later than several other publications on the point.

It is some years since Dr. Mateer first announced psychometric findings distinctive for congenital syphilis. A chapter is devoted to this matter, on which the author stands firmly to her guns. Generally inferior motor ability stood out clearly; the group are better in imaginal and verbalistic functions, and less good in "motor control and kinesthetic appreciation." There is fairly detailed presentation of the data, and Dr. Mateer apparently feels that the mental criteria can be given positive weight equal, if not prior, to serological methods.

The style of the book is more vivacious than is usually associated with such themes. At the same time there is no tendency to minimize the difficulties of the problems, or to arouse exaggerated expectations. The viewpoint is broad, and there are several entertaining philosophical reflections.

From the point of view of case presentation, a middle course is steered between considerable detail with few individuals, and a less full but more comparative treatment of larger numbers. Both types of presentation are illustrated, but the book would probably gain by additional presentations of the order chapter XI, devoted to the history of a single case. The medical aspect of the topic is not overstressed; the circumstances under which the material was derived were hardly conducive to error in this direction. Considerable stress is laid on the concept of "psychopathy," a term in psychiatric usage differential with feeble-mindedness, and the further distinction of the two concepts is a useful one. The second part of the book is indeed entitled "The Practice of Psychopathy" which, like the title of the whole book, is somewhat beside the mark; happily it does not denote a vade-mecum *für Irrsinnige, oder solche, die es werden wollen.*

Dr. Mateer's early training was in an environment dominated by one with all the contempt of genius for conventionalities of diction. The influence seems to survive in a few such expressions as torpitude and encroachage. Did the author's illustrious preceptor also use rule of thumb to denote meticulousness, disinterested as equivalent to uninterested, data with a singular verb, and write aufgabe thus, like a word of English? Dr. Mateer warns that accumulations of elaborate apparatus and "engraving-like beauty in written reports" are at times compensations for deficiencies of clinical capacity and judgment. So may these rhetorical peccadilloes be themselves but the foil of high excellence and trustworthiness in more vital things.

F. L. Wells

Boston Psychopathic Hospital

SPECIAL ARTICLES

NEW MEASUREMENTS OF PLANETARY RADIATION

IN view of the fact that the popular press has not yet reached such a stage of reliability that one can turn to it for accurate information on scientific subjects this seems an appropriate time and place to record some of the results of our recent measurements on the radiation emitted by the major planets.

Continuing our measurements of 1922, by means of suitable transmission screens the planetary radiation, which consists of wave lengths of 8 to 14 μ, has been successfully separated into spectral components. In this manner it is possible to determine the shape of the spectral energy curve of that part of the planetary radiation which is transmitted by our atmosphere and thus form an estimate of the temperature of the planetary surface.

In the case of Mars, these radiometric measurements show that the equatorial zones are much warmer than the polar regions which emit practically no planetary radiation; the morning side of the planet is at a lower temperature than the afternoon side which has been exposed to the sun's rays for a longer time; the dark regions are at a higher temperature than the light ones, and a gradual rise in temperature of the surface of the southern hemisphere, where summer is now advancing, was recorded.

Tests were applied showing that there is an excess of incoming low-temperature radiation from the planet over the outgoing radiation from the radiometer receiver, which could not occur if the temperature of the effective radiating surface of Mars were at a lower temperature (15° C.) than the receiver.

A direct comparison was made of the spectral components (λ 8–12.5 μ and λ 12.5–5 μ) of the planetary radiation from Mars with similar measurements on the moon, which is commonly supposed to have a temperature of 50 to 100° C. or even higher. This with two other methods of comparison indicate that the temperature of Mars, under a noonday sun, is up to 20° C. or even higher.

In the case of Venus not only does the illuminated crescent show the presence of considerable planetary radiation, but the unilluminated part of the disk also emits a large amount of infra red rays. The planetary radiation (per unit surface) from the unilluminated part of the disk amounts to about 10 per cent. of the total radiation from the brightly illuminated crescent. This radiation is highly selective, the spectral component of wave lengths λ 8–12.5 μ being over 60 per cent. of the total planetary radiation measured.

W. W. COBLENTZ,
C. O. LAMPLAND
FLAGSTAFF, ARIZONA

THE EXPERIMENTAL REVERSAL OF POLARITY IN PLANARIA

THE establishment of polarity is a universal and fundamental phenomenon among organisms, and since it must precede all further differentiation it is important to understand just what is the basis of polarity itself. Although polarity shows itself as a matter of visible structure, it is probably fundamentally a dynamic phenomenon, the visible polarity being the expression of the physiological activities of the individual; this expression should therefore be capable of reversal if the controlling activities are reversed. Polarity is most susceptible of analysis through regeneration experiments on simple, axiate forms such as Tubularia or Planaria, which have consequently been much used in its study. Both of these forms are definitely polarized along an axis, and this polarity ordinarily reappears in the regeneration of an isolated piece of the body.

Both Morgan[1] and Loeb[2] considered polarity as dependent upon definite organ-forming substances, Morgan postulating a gradation of hydranth-forming substance in the stem of a tubularian and Loeb a condition in the protoplasm "of the nature of a current (*e.g.*, of liquid) by which certain substances were carried through the stem." Mathews[3] reported differences of electrical potential between the anterior and posterior cut surfaces of a stem of hydroid and believed these differences to be due to unequal degrees of protoplasmic activity at different regions.

Child's gradient theory[4] regards polarity as an expression of a gradient along the polar axis. This gradient is susceptible of measurement as a gradation in rate of metabolism, in differences of electrical potential at different points along the axis, or in other ways. Miss Hyman[5] has shown that the anterior end of an isolated piece of a planarian, which is undergoing metabolism more rapidly than is the rest of the piece, is electronegative, galvanometrically, to the posterior end, where the rate is lower. There is a certain stimulation of metabolic activity as a result of cutting, and this, according to Miss Hyman, causes chemi-

[1] Morgan, T. H., 1905, "Polarity considered as a phenomenon of gradation of materials." *Jour. Expt. Zool.*, Vol. 2, p. 495.

[2] Loeb, J., 1906, "The Dynamics of Living Matter." Columbia University Press.

[3] Mathews, A. P., 1903, "Electrical polarity in the hydroids." *Am. Jour. Physiol.*, Vol. 8, p. 294.

[4] Child, C. M., 1915, "Individuality in Organisms." University of Chicago Press.

[5] Hyman, L. H., 1918, "Suggestions regarding the causes of bioelectric phenomena." SCIENCE, N. S., Vol. 48, p. 518.

cal changes which are directly responsible for the electropotential differences.

Child's experiments on planaria show that in a piece cut from that portion of the animal just posterior to the pharynx, the original polarity usually gains a new expression in regeneration, a new head appearing at the anterior end; the anterior end dominates the rest of the piece and the natural response of a dominant, undifferentiated region in a piece of planarian is the formation of a head. Polarity, however, may be altered, as is witnessed by all cases of heteromorphosis. Lund[6] has reported cases of partial reversal of polarity in *Bursaria* and has completely reversed the polarity of *Obelia commisuralis* by means of the electric current. This reversal was apparently due to direct action of the current on the electrochemical polarity of the organism, but if electrochemical polarity is the result of metabolic differences it should be possible to control the expression of polarity by any external influence which would properly affect metabolism. It is this sort of a regulation of polarity which I have studied, under the direction of Dr. J. Frank Daniel, and wish here to report.

Short, transverse pieces were cut just posterior to the pharynx, from normal, averaged sized individuals of *Planaria maculata,* collected in the Golden Gate Park in San Francisco, and allowed to regenerate. The percentage of cases in which the original polarity reappeared in regeneration was very large. Occasionally, however, there was developed a heteromorphic individual, with a head at either end. Such individuals developed only from extremely short pieces, and in all cases the head which appeared at the originally anterior end of the piece was slightly larger and better developed than the posterior head, which frequently showed some abnormality of the eyes or other feature. In such a case, although there has been obviously some disturbance of the simple, axiate polarity of the normal worm, there is not a real reversal of the polarity of the individual as a whole, for the originally anterior region is still able to exert a certain degree of dominance over the whole individual. It is, however, a partial reversal, for the tail has become the head. It should therefore be possible to secure an individual of completely reversed polarity by separating this posterior portion, which has to a certain extent attained an individuality of its own, from the anterior, partially dominant individual. Complete reversal of polarity was actually accomplished in this way, for when the two heads were separated, each of the resulting pieces became an apparently normal worm, a tail developing at each cut surface. The posteriorly directed heads were in some cases watched for more than two weeks after isolation and always retained the reversed polarity, developing into worms apparently quite normal and with a pharynx normally placed, but which were, in the matter of polarity, the exact opposites of the individuals from which the pieces were originally obtained.

A piece isolated from the body of a planarian must of necessity undergo a considerable rearrangement in all its life processes; it is only because these processes are extremely simple and generalized that the piece can at all survive such isolation. Since the metabolic gradient extends the length of the organism any isolated piece will possess a part of the gradient, so that the anterior end of the piece will be undergoing metabolism more rapidly than is the posterior end. But the establishment of polar relations in the new individual is also partially dependent upon the stimulation of the act of section. The anterior cut surface has been set free from all more anterior levels and is thus stimulated to a greater extent than is the posterior cut surface, which is still under the dominance of the regions above it in the gradient. Given an ordinary, isolated piece, Child explains that head frequency or capacity to form a head at the anterior end of the piece may be expressed by the ratio rate x/rate y, where rate x is the metabolic rate of the cells at the anterior surface and rate y that of the piece as a whole. If rate x is high enough to dominate the piece as a whole, a head will form, but if rate y is high relative to rate x, an imperfect head or none at all will form. In a very short piece, such as those which give rise to the heteromorphic individuals, the initial gradient can not be very pronounced, and on the cells at the posterior cut surface, which may be called the z cells, the stimulation of section may consequently be almost as great as on the x cells, making the z region also independent of the piece as a whole. In that case, head frequency for a posteriorly directed head may be expressed by the ratio rate z/rate y. The heteromorphic individuals may be considered as possessing two oppositely directed gradients which meet at their lowest points, and when these gradients are separated, each piece should regenerate with relation to its own gradient, uninfluenced by the gradient of the other; such indeed was seen to be the case. The two worms thus produced from a single piece taken from the "parent" worm appear to be identical in form, activity, etc., but when their origin is considered, it will be recognized that one is the direct opposite of the other.

The reestablishment of polarity thus seems to depend on a balance between the very strong factor of a previously established polarity and various external influences, which are able materially to affect this

[6] Lund, E. J., 1917, "Reversibility of morphogenetic processes in Bursaria." *Jour. Expt. Zool.,* Vol. 24, p. 1. 1921. "Experimental control of polarity by the electric current." *Jour. Expt. Zool.,* Vol. 33.

polarity only when that factor is weakened by some such condition as unusual shortness of the piece.

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THE EFFECT OF DRYING UPON THE ACIDITY OF SOIL SAMPLES[1]

BURGESS[2] has recently reported a study of the effect of air and oven drying upon the H-ion concentration of soils, using samples of Miami silt loam from a series of plots at the Rhode Island Agricultural Experiment Station. He found that drying had little or no effect upon acid soils, but increased the H-ion concentration of alkaline soils.

In an investigation of the H-ion concentration of Minnesota soils that has been in progress for some time at this laboratory, numerous samples of soil from different parts of the state and from soil types of different genesis have been tested. Early in the investigation we tried to determine the proper conditions of moistness and freshness of the samples and have now satisfied ourselves that the determinations should be made with soil freshly taken from the field from which little or no moisture has been allowed to escape. Only then are the results a reliable indication of the conditions actually existing in the field.

In order to determine the effect of drying upon the H-ion concentration, we made determinations upon about 200 samples of soils in both the moist and the air-dry condition. With part of these oven-dried samples also were used. All the determinations were made by the gas chain electrometric method.

Comparing samples from five of our experimental fields, the soils of which are naturally acid, we find that samples from one field show marked changes upon being allowed to become air dry; those from two fields change somewhat less, but still appreciably, and those from the remaining two change only slightly. Generally the H-ion concentration increased, but in a few instances it decreased. With the samples from plots where sufficient lime or marl had been added to make the soil alkaline, some showed no change in H-ion concentration, some an increase and others a decrease upon air-drying.

A group of 92 glacial soils, partly acid and partly alkaline, were found after air-drying to be decidedly more acid than before, the alkaline soils, however, showing the more marked change. A group of loessial soils, on the whole more acid than the glacial soils, showed less change.

Oven-drying was found to increase the H-ion concentration more than air-drying. Samples moistened after air-drying became more acid than the original moist samples and usually more acid than the air-dried samples. Moist samples kept in air-tight glass containers generally become more acid on standing; out of 20 samples tested, 13 became more acid, five showed little change and two became less acid.

H-ION CONCENTRATIONS OF FRESH AND DRIED SOILS SHOWING VARIABLE EFFECT OF DRYING AND REMOISTENING

Sample No.	Formation	Fresh pH	Air-Dried pH	Oven-Dried pH	Remoistened pH
1	Glacial Outwash	5.53	5.79	......	......
2	" "	6.32	5.33	5.21	......
3	" "	7.20	6.54	6.04	......
4	" "	7.34	7.66	......	......
5	Till Plain	5.44	5.19	......	5.28
6	"	5.60	5.46	......	5.04
7	"	5.78	5.74	......	......
8	"	6.20	5.90	5.55	5.50
9	"	6.49	5.11	......	......
10	"	7.19	6.54	......	6.15
11	"	8.00	7.39	7.79	......
12	Loessial	5.87	5.80	5.31	......
13	"	6.32	5.90	5.19	5.02
14	"	6.63	6.12	5.34	......
15	"	7.51	7.13	......	......

Air-dried samples, when tested by the qualitative potassium thiocyanate method, gave a more acid reaction than moist ones freshly taken from the field. The full data are now being prepared for publication, but the accompanying few given in the table will serve to illustrate the magnitude of the changes we have found.

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[1] Published with the approval of the director as Paper No. 373 of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] SCIENCE, 1922, N. S., 55, 647–648.

THE BENEFICIAL EFFECT TO WHEAT GROWTH DUE TO DEPLETION OF AVAILABLE PHOSPHORUS IN THE CULTURE MEDIA

THE exceptionally good growth wheat seedlings, grown four weeks in complete nutrient solutions, make when transferred to aqueous culture media that contain all essential nutritive salt elements except phosphorus, presents a problem of great importance from the standpoint both of theory relating to fertilizer practice and of that pertaining to the physiology of the wheat plant. In experiments designed to test the effects of the absence of the commonly assumed essential elements in the culture media at various stages of growth on the development of wheat, it

was found that eight weeks after the transfer above referred to was made, the cultures grown in media devoid of phosphorus far excelled those grown in complete nutrient solutions that were not allowed to be markedly depleted of any essential salt elements. The former set of cultures exceeded the latter in height, weight of plants and earliness of heading. Comparison as to height was 50 inches and 36 inches and that of the weight of green plants 700 grams and 480 grams. Wheat grown an equal length of time from the early seedling stage in nutrient solutions devoid of phosphorus made very little growth, the weight being approximately 30 grams. It appears, therefore, that while phosphorus is needed in the early growth period of wheat, it is not only useless, but relatively harmful, if present in appreciable quantities in physiologically available form in the culture media for the latter growth periods.

These results call for a marked revision of the theory underlying the use of phosphates as fertilizers. The fact that the absence of phosphorus in aqueous culture media during approximately three fourths of the entire growth period of wheat, which included the fruiting stage, is decidedly beneficial not only suggests but is inferential evidence that analogous conditions may prevail in soils, and that large yield of wheat (and presumably that of other crops) results from and is conditioned by the depletion of physiologically available phosphorus in the soil during certain periods of growth of the plants. If the thesis in ecological principle and plant adaptation is true, as it appears it must be, that whatever growth a plant makes under any given set of conditions is the best growth for that particular set of conditions, then the beneficial effect to plant growth of the absence of phosphorus in the nutrient solution, as compared with one that contains this element for the particular phase of growth to which it applies, is the expression of an ecological factor concerned in crop production, to which wheat has become adapted to produce maximum yield.

But is phosphorus in fertile soils generally physiologically unavailable to wheat plants during the later phases of their growth? Answer to this question involves consideration of several points. In the first place, while it is generally assumed that if phosphorus in the soil is in water-soluble form, it is therefore physiologically available, nevertheless results of physiological experimentation have neither satisfactorily proved nor disproved this assumption. As physiological availability of an element is determined by the measure of growth it has produced and not by the amount of that material absorbed by the plant, it follows that neither chemical analysis of plant nor of water extract of that soil can give the answer. However, as analyses of soil extracts show that the concentration of water soluble phosphorus is usually very low during the greater part of the growing period of cereal plants, it appears, therefore, that the mechanics in the soil that meet these particular physiological requirements of the plants to render phosphorus unavailable for the later growth phase of wheat, lies in the low rate of solution of this material.[1]

As already mentioned in a previous paper,[2] results obtained from this type of experimentation led the writer to define the crop-producing power of soils as a function of the rate of the temporary depletion of certain nutrients in physiologically available form. Because plant growth is improved by the seasonal depletion of certain nutritive elements in the growth media, therefore yield of crop can not be expressed as a function of the supply of available nutritive material either in aqueous culture media or in the soil. The supply of nutritive material is only one factor of the more comprehensive expression herein stated that defines crop-production as the correlated response of progressive and changing conditions in the soil.

The fact that for certain periods of growth of the plants the absence in the culture media of material extensively used as a fertilizer is decidedly beneficial to plants must necessarily call for a thorough study of the economy and use of fertilizers in general. In no way have the results of the experiments herein quoted invalidated the soundness and economy of the use of phosphates on land when needed. However, due to the fact that in innumerable experiments, no increase in production obtained where phosphates or other fertilizers were applied, it is quite obvious that some heretofore unaccounted for factor had been operative to negative anticipated or hoped for results. But in the light of this investigation, which shows certain nutritive elements may be required at certain phases of growth of plants and not at others, or are beneficial at certain phases of plant development and relatively harmful at others, it follows that a rational basis of fertilizer application can be founded only on the knowledge of nutritive requirements of plants at various phases of growth and on that of the progressive changes that take place in the supply of physiologically available nutritive material in the soil.

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[1] Burd, J. S., and Martin, J. C. "Secular and seasonal changes in the soil solution" (in preparation).

[2] "The beneficial effect to plant growth of the temporary depletion of some of the essential elements in the soil," W. F. Gericke, SCIENCE, April 4, 1924, Vol. LIX: 1527.

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THE FIFTH ESTATE[1]

BENJAMIN FRANKLIN was not perhaps in all respects a paragon, but he was unquestionably a polygon—a plain figure with many sides and angles. There were not enough buttons on his black coat to tell off the multifarious aspects in which his complex personality was presented to the world. He was craftsman and tradesman; philosopher and publicist; diplomat, statesman and patriot. And he was, withal, a very human being. What concerns us particularly on this occasion is the fact that he was at once philosopher and man of affairs. His remarkable career should refute forever the fallacy, which, unfortunately, still is current, that the man of science is temperamentally unfitted for the practical business of life.

At the time when Franklin was in England the British Parliament was assumed to be composed of representatives of three estates: the lords spiritual, the lords temporal and the commons, but Edmund Burke, pointing to the Reporters' Gallery, said, "There sits a *Fourth Estate,* more important far than they all." No one at all familiar with the ubiquitous influence and all-pervading power of the press would to-day question the validity of Burke's appraisal. Even then, however, there was present in England in the person of Benjamin Franklin a prototype and exemplar of the membership of a *Fifth Estate,* an estate destined to play an even greater part than its predecessors in the remaking of the world.

This Fifth Estate, to which your attention is appropriately invited on the centenary of the Franklin Institute, is composed of those having the simplicity to wonder, the ability to question, the power to generalize, the capacity to apply. It is, in short, the company of thinkers, workers, expounders and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge which we call science. It is their seeing eye that discloses, as Carlyle said, "the inner harmony of things; what Nature meant." It is they who bring the power and the fruits of knowledge to the multitude who are content to go through life without thinking and without questioning, who accept fire and the hatching of an egg, the attraction of a feather by a bit of amber, and the stars in their courses as a fish accepts the ocean.

[1] Delivered in connection with centenary celebration of the founding of the Franklin Institute and the inauguration exercises of the Bartol Research Foundation on September 19, 1924.

The curious deterioration to which words are subject has left us with no term in good repute and common usage by which the members of the Fifth Estate may properly be characterized. Sophists are no longer distinguished for wisdom: they are now fallacious reasoners. Philosophers, who once claimed all knowledge for their province, are now content with speculative metaphysics. Scholars have become pupils. The absent-minded and myopic professor is a standardized property of the stage and screen. The expert, if not under a cloud, is at least standing in the shade. In Boston one hesitates to call a professional man a scientist, he may be a Presbyterian; and a "sage," as an anonymous writer has pointed out, "calls up in the average mind the picture of something grey and pedantic if not green and aromatic." Let us, therefore, for a time at least, escape these derogations and identify ourselves as members of the Fifth Estate.

Although the brotherhood of the Estate is open to all the world, its effective membership nowhere comprises more than an insignificant proportion of the population. Two hundred and fifty constitute the membership of the National Academy of Sciences. The latest edition of "American Men of Science" includes only about 9,500 names. The number is expanded to 12,000 on the roll of the American Association for the Advancement of Science. Although gathered from all countries and though chemistry is one of the most active and inclusive sciences, the chemical papers, books and patents reviewed in *Chemical Abstracts* in 1923 were the product of about 22,000 workers. One may hazard the estimate that there are not in all the world 100,000 persons whose creative effort is responsible for the advancement of science.

The studies of Cattell indicate that in America, at least, the great majority of men of science come from the so-called middle and upper classes, or precisely those sections of society which, in Russia, have been practically exterminated in the name of the new Social Justice. In about two thirds of Cattell's reported cases both parents were American-born, while the fathers of nearly one half were themselves professional men. Seventy-five per cent. are dependent upon the universities for support, from which we may assume that the burden of the higher surtaxes does not bear heavily upon the Fifth Estate.

In proportion to population the cities have produced twice as many scientific men as the country, but how many "hearts once pregnant with celestial fire" repose in country churchyards because of lack of opportunity and absence of the stimulus of contact can not, of course, be known, nor can we tell how many brains competent and equipped to penetrate the mysteries of nature the war has cost the world.

Initiative is one of the rarest mental qualities, yet without it progress is impossible. Its combination with the scientific imagination and command of fact is still rarer and more precious. Since comparatively few of those who study science develop the capacity to extend its borders the cost of a man competent to advance science has been estimated at $500,000 and his value to the community set at a far greater figure. Full membership in the Fifth Estate thus seems to involve the highest initiation fee on record. It is a figure disconcerting to the candidate, but as Wiggam has finely said: "Only genius can create science, but the humblest man can be taught its spirit. He can learn to face truth."

That the Fifth Estate is not better appreciated or always understood by the world at large is not surprising. In their endeavors to secure accuracy of definition and expression its members have evolved a preposterous and terrifying language of their own. It is not ideally adapted to the interchange of confidences in ordinary human intercourse. It does not lend itself to poetry. "Ladybird, ladybird, fly away home" becomes impossible when one is forced to address the prettily spotted beetle as *Coccinella dipunctata*. A primrose by the river's brim is much more than a yellow primrose to the botanist: it is a specimen of *Primula vulgaris*. The organic chemist produces a new synthetic product in a mass of pilular dimensions and bestows upon it a name that would slow up Arcturus. Nothing but static interference can account for the terms of radio telephony. If knowledge is to be humanized it must first be translated.

Dewar has said that the chief object of the training of a chemist is to produce an attitude of mind. It should be the object of all education to produce the scientific attitude toward truth. We may even agree with Robinson that "of all human ambitions an open mind, eagerly expectant of new discoveries and ready to remould conviction in the light of added knowledge and dispelled ignorances and misapprehensions, is the noblest, the rarest and the most difficult to achieve."

Carlyle says, "The degree of vision that dwells in a man is a correct measure of the man." And President Coolidge has been quoted as saying in a recent interview:

> Everything that flows from the application of trained intelligence and invested capital is the result of brains. . . . The man of trained intelligence is a public asset. . . . We go forward only through the trained intelligence of individuals but we, not the individuals, are the beneficiaries of that trained intelligence. In the very nature of things we can not all have the training but we can all have the benefits.

Now vision, a trained intelligence and an open mind are the qualities which characterize all those who are worthy of membership in the Fifth Estate. They are qualities which the many-sided Franklin possessed in exceptionally high degree.

Among all the activities with which his busy life was crowded Franklin undoubtedly found his greatest pleasure in the pursuit of science, and in that pursuit he followed the eclectic method. At a time when nearly everything awaited explanation his focused attention ranged like a searchlight over many fields. He observed the movement of winds and developed a theory of storms. He considered ventilation and the causes of smoky chimneys and proceeded to invent new stoves. He introduced the Gulf Stream to Falmouth skippers and demonstrated the calming effect of oil on turbulent seas to officers of the British Navy at Portsmouth. From earthquakes he turned to the heat absorption of colored cloths and the fertilizing properties of gypsum. He wrote on sun spots and meteors, waterspouts, tides and sound. The kite, which for centuries had been the toy of boys, became in Franklin's hands a scientific instrument, the means to a great discovery. That its significance is, even now, not universally appreciated is shown by the recent answer of a schoolboy, "Lightning differs from electricity because you don't have to pay for lightning." To Franklin, as the child of every man knows, we owe our initial conceptions of positive and negative electricity and he was the first to suggest that the aurora is an electrical phenomenon.

The gregariousness, which is a prominent characteristic of the Fifth Estate, found early expression in Franklin. He formed The Junta, a club for the discussion of morals, politics and natural philosophy, and in 1744 drew up a proposal for the organization of the American Philosophical Society, of which later he became president. He established a wide acquaintance and cemented many firm friendships among the foremost scientific men of France and England, by whom he was received on equal terms. In 1753 he was awarded the Copley medal of the Royal Society for his discoveries in electricity and on his leaving England, David Hume wrote: "I am sorry that you intend soon to leave our hemisphere. America has sent us many good things, gold, silver, sugar, tobacco, indigo, but you are the first philosopher and indeed the first great man of letters for whom we are beholden to her."

The professional spirit which animates the Fifth Estate is essentially one of service. Its compelling urge in the search for truth springs from the conviction that the Truth shall make men free. That spirit finds complete expression in Franklin's statement, "I have no private interest in the reception of my inventions by the world, having never made nor proposed to make the least profit by any of them." This impersonal relation to the children of his brain was indeed carried by him to an extent which ordinary human nature would find hard to emulate. "I have," he writes, "never entered into any controversy in support of my philosophical opinons; I leave them to take their chance in the world. If they are right, truth and experience will support them; if wrong, they ought to be refuted and rejected."

There is, nevertheless, a place for militancy in science. The world needs a Huxley for every Bryan.

Franklin was a man of science, but his career proclaims that it is possible to be a man of science and much more besides. Science was made for life and life is more than science. Art in its fullest expression may touch deeper springs, human relations and affections may bring richer rewards, and public affairs may make a more imperious claim. With Franklin as their prototype the members of the Fifth Estate may well strive to emulate his devotion to the public service and his broad and constructive interest in human problems and affairs.

Error and misconception have a feline tenacity of hold upon life, and the Fifth Estate, though richly endowed with latent executive capacity, is still in popular opinion regarded as equipped for thought rather than for action. The practical man, busily engaged in repeating the errors of his forefathers, has little time and less consideration for the distracting theories and disconcerting facts of the man of science. Yet who, among the men of action, is more intensely and truly practical than Carty, Baekeland, Reese or Whitaker? Where shall one find a firmer grasp on the details of business than that possessed by E. W. Rice, Jr., Gerard Swope or Dr. Nichols? What quality caused the young director of a research laboratory to find himself responsible for the production of gas masks to protect four million fighting men? In a time of dire emergency it was a professor of chemistry who organized the great Edgewood Arsenal and developed the means and methods and the trained personnel required to supply munitions for a new type of warfare. It was not to a statesman or a business man or a great manufacturer that the Allies entrusted the supreme command. It was to a teacher in a French military school. The range and value of their public service obscures the fact that Charles W. Eliot was a professor of chemistry and that Hoover is an engineer. The League of Nations is the child of a schoolmaster.

Numerically the Fifth Estate has always been feeble and insignificant. Its total membership at any time could be housed comfortably in a third-rate city. No politician makes a promise or invents a phrase to attract its scattered and ineffective vote. Rarely do its

members sit in Congress: when they do they sit in the gallery.

With less political influence than the sparse population of Nevada the Fifth Estate has recast civilization through its study and application of "the great and fundamental facts of Nature and the laws of her operation." It has opened out the heavens to depths beyond imagination, weighed remote suns and analyzed them by light which left them before the dawn of history. It has moved the earth from the center of the universe to its proper place within the cosmos. It has extended the horizon of the mind until its sweep includes the 30,000 suns within the wisp of smoke in the constellation Hercules and the electrons in their orbits within the atom. It has read the sermons in the rocks, revealed man's place in nature, disclosed the stupendous complexity of simple things, and hinted at the underlying unity of all.

Because of this new breadth of vision, this lifting of the corner of the veil, this new insight into the hidden meaning of the things about him, the mind of man, cramped for ages by taboos and bound by superstition, is emerging into freedom: into a new world rich in promise and of surpassing interest and wonder.

Man brought nothing into the world and through long and painful ages he added little to that nothing: a club, an ax of stone, a pebble in a sling, some skins of beasts, a rubbing of sticks for a fire. He might labor, but to what avail? Even to-day the South American Indian works incessantly, yet his labor produces little more than heaps of stones. To those who would have us believe that all wealth is produced by labor the Fifth Estate replies, "Wealth is the product of brains, and labor is productive only as it is guided by intelligence."

Science is the great emancipator of labor. Bagehot has somewhere said, perhaps in "Physics and Politics," that, during the early stages of civilization, slavery was essential to progress because only through the enforced labor of the many could the few have leisure to think. To-day, in the United States, the supply of available energy is equivalent to sixty man power for every man, woman and child. There is now leisure for all to think, but the millions prefer the movies.

It is not labor but the trained intelligence of the Fifth Estate which has endowed man with his present control of stupendous forces. It has solved problems that for ages have hindered and beset mankind. It has revealed great stores of raw materials, synthesized scores of thousands of new compounds, furnished the fundamental data which find embodiment in machines and processes and in those agencies of transportation and communication that have made of the world a neighborhood. It has enabled man effectively to combat disease, added years to the average life, and made it better worth the living.

Benjamin Franklin died in 1790—one hundred and thirty-four years ago. Could he return to make appraisal what wonders would confront his astonished vision, what triumphs of the Fifth Estate compel his admiration!

Electricity, which to his contemporaries was little more than an obscure force, the curious manifestations of which might supply an evening's entertainment, has become the structural basis of the universe. The atom of Democritus is now a microcosm, vibrant with energy that glows in the white light of the electric lamps, which have replaced the tallow dip. In place of the electrophorus and the charges of the Leyden jar he would find in our own country alone twenty-seven million horsepower driving generators in thousands of stations from which electric energy is distributed to our homes and factories and transportation lines to perform innumerable services. Imagine, if you can, the stunning impact of the impressions that would crowd the day of his return. With what amazement would he converse over a wire from Philadelphia to San Francisco or hear a voice transmitted through the ether from a point halfway around the world. So commonplace a thing as a street car would leave him open-mouthed with wonder, which might well increase at sight of an electric locomotive, hauling its hundreds of tons of freight.

In great industrial plants he would find electricity driving machines of an intricacy, precision and productive power beyond the imagination of his generation, or at work in decomposing cells and in the heart of glowing furnaces fashioning new products. In university and corporation laboratories would be revealed to him the marvels of the X-rays, photography, the fascinating world of the microscope, balances weighing 1/100,000th of a milligram, the spectroscope and all those instruments of precision and research which are the tools of the Fifth Estate. Elements unknown to him would be placed in his hand; fascinating experiments performed to demonstrate properties and relationships beyond his dream. The air, which he studied with reference to winds, combustion and ventilation, would be reduced before him to a liquid as obvious as water, though boiling on a cake of ice.

Where once the postboy and the post chaise were familiar he would find our roads crowded with automotive vehicles and the country gridironed by the railways. Did he wish to send a letter across the continent, he would have only to commit it to the air mail to ensure its arrival in thirty-six hours. Were he called upon to revisit England, there would be no ten-weeks' voyage in a sailing packet, but the speed and luxury of a 50,000-ton liner, oil fired and turbine driven. At Portsmouth, where he calmed the waves

with oil, he would find, instead of wooden frigates and smooth-bore cannon, submarines and armored superdreadnaughts, a single gun of which could sink the entire British Navy as he knew it. Did he wish to proceed to Paris, he would have only to take passage in an aeroplane.

The gardeners Franklin knew grew peas for pleasure or profit. Mendel grew them and established the laws of heredity. Farming, which was a wholly empirical occupation, is now the special concern of a great governmental department devoted to the development of scientific agriculture. Here Franklin would learn of soil analysis and seed selection, of hardier and more prolific varieties of plants, of better breeds of animals, of methods of control of such virulent diseases as splenic fever, anthrax, hog cholera and bovine tuberculosis. He would find his own experiments with gypsum extended to cover the whole field of chemical fertilizers, the air itself converted into an inexhaustible reservoir of plant food, and the efficiency of farm labor multiplied many times by ingenious agricultural machines.

He would find household economics revolutionized: the town pump replaced by running water; electricity a servant in the house; the food supply broadened and stabilized; domestic drudgery assumed by laundry, bakery and factory; tasteful clothing within the reach of all; transportation and amusement for the multitude, and the history of yesterday sold for a penny. Innumerable new industries based on the findings of the laboratory now offer the means of decent livelihood to millions and open careers to thousands.

In great hospitals, permeated with the scientific spirit and equipped with many new and strange devices for the alleviation of human suffering, he would hear of the incalculable benefits which medical and surgical science have conferred upon mankind. He would see the portraits and listen to the story of Pasteur and Lister and Loeb and Ehrlich. We know to-day with what joy and relief the world would welcome a veritable cure for cancer, but we can little realize the emotion with which one like Franklin would learn in a single afternoon of the germ theory of disease, of preventative serums, of antisepsis, of chemotherapy, of the marvelous complexity of the blood stream and the extraordinary influence and potency of the secretions of the ductless glands. What appraisal would he make of the service to humanity which, in little more than a generation, has mitigated the horrors of surgery by the blessings of anesthesia and antisepsis, which has controlled rabies, yellow fever, typhoid fever, tetanus, which is stamping out tuberculosis, curing leprosy, and providing specifics for other scourges of the race. What values would he put on insulin, thyroxin, adrenalin. The physician is no longer compelled to rely on herbs and simples and drastic mineral compounds of doubtful value and uncertain action. Compounds of extraordinary potency, isolated or synthesized by the chemist, are now available to allay pain, correct disorders, prolong life and even to restore mentality and character.

With contributions to their credit which have so enriched and stimulated the intellectual life; which have brought the peoples of the earth together into closer touch than English shires once were; which have revolutionized industry, enlarged the opportunity of the average man, and added so greatly to his comfort and well-being, we may reasonably inquire, "What are the recompenses of the Fifth Estate?"

On the material side they have almost invariably been curiously inadequate and meager. It is incomparably more profitable to draw the Gumps for a comic supplement than to write "The Origin of Species." There is more money in chewing gum than in relativity. Lobsters and limousines are acquired far more rapidly by the skillful thrower of custard pies in a moving-picture studio than by the no less skillful demonstrator of the projection of electrons. The gate receipts of an international prize fight would support a university faculty for a year.

One may recall that Lavoisier was guillotined by a republic that "had no need of chemists," that Priestley was driven from his sacked and devastated home, that LeBlanc, after giving the world cheap alkali, died in a French poorhouse, that Langley was crushed by ridicule and chagrin in his last days. A month before the war who could have believed that within a few years the Fifth Estate in Russia would be utterly destroyed and in Germany and Austria existing at the very edge of starvation. What has happened there may happen again elsewhere if the intelligence of the world does not assume and hold its proper place in the direction of national and world affairs.

In the preface to his recent "Lehrbuch der Photochemie" Professor Plotnikow has written: "Home and property were pillaged by bands of idle Russians who used my library for cigarette papers. Hunger, misery, want and personal insecurity, often approaching fear for my life, were the constant accompaniment of my labors."

One is reminded that Carlyle, on the authority of Richter, says: "In the Island of Sumatra there is a kind of 'light-chafers,' large fireflies, which people stick upon spits, and illuminate the ways with at night. Persons of condition can thus travel with a pleasant radiance, which they much admire. Great honor to the fire-flies, but — ! —"

It is not becoming that the world expect the light

to shine indefinitely when carrying a lantern is often less remunerative than carrying a hod. The money and the years of study required for special training are not recognized as invested capital, and the return from a decade of research is often taxed as the income of a year. Professorial salaries move forward as slowly as a glacier, but they seldom leave a terminal moraine. Yet teaching is our most important business, for a failure to pass on for a single generation the painfully accumulated knowledge of the race would return the world to barbarism.

Though material wealth is rarely acquired by the Fifth Estate, they have the riches of the royal man, defined by Emerson as " he who knows what sweets and virtues are in the ground, the waters, the plants, the heavens, and how to come at these enchantments." Their wealth is in the kingdom of the mind. It is inalienable and tax-exempt. It may be shared and yet retained.

A recent survey by a national magazine would seem to indicate that the majority of men have drifted into their vocations with little effort of selection and that a very large proportion ultimately regret their choice. This is seldom true of members of the Fifth Estate. Theirs is a true vocation, a calling and election. It brings intellectual satisfactions more precious than fine gold. They live in a world where common things assume a beauty and a meaning veiled from other eyes; a world where revelation follows skillful questioning and where wonder grows with knowledge. Together they share the interests, the communion of spirit, the labors and the triumphs of the fraternity of science. The law of diminishing returns exerts a control from which there is no escape in agriculture, industry and business. Research alone is beyond the twelve-mile limit of its inhibitions.

If "the Heavens declare the glory of God" that glory is surely made more manifest by telescope and spectroscope. If the whirling nebulae and the stars in their courses reveal omnipotence, so do the electrons in their orbits reveal His presence in universes brought into being by the striking of a match. The laboratory may be a temple as truly as the church. The laws of nature are the will of God, their discovery is a revelation as valid as that of Sinai, and by their observance only can man hope to come into harmony with the universe and with himself.

There has been a general and ready acceptance by the world of the material benefits of science, while its contributions to sociology and ethics are as generally ignored as guides to human conduct. Yet science proclaims new commandments as inflexible as those engraved on stone and furnishes what Wiggam has reverently termed "the true technology of the will of God."

Science has so drawn the world together and so rapidly remoulded civilization that the social structure is now strained at many points. Statecraft and politics, law and custom lack the plasticity of science and are now in imperfect contact with the contours of their new environment. The result, as events have shown, is friction and confusion. Though our civilization is based on science, the scientific method has little place in the making of our laws. Office does not seek the man in the laboratory, and candidates are not pictured as engaged in any activity that might suggest a superior intelligence. They are shown milking cows, pitching hay in new blue overalls, or helping with the family washing. Recently, in the senate of a New England state, there was presented the edifying spectacle of the presiding officer, being shaved by a barber, called to the rostrum, while senators were reading the encyclopaedia into the record. To expedite further the public business sundry members of the chamber were presently gassed with bromine. Does not this suggest that a few chemists might with advantage be distributed among our legislative bodies?

It is claimed that fifty per cent. of the members of state legislatures in America have never been through high school and that only one in seven has been through college. We see in the ranks of science knowledge without power and in politics power without knowledge. An electorate, which regards itself as free, listens to the broadcasted noise of manufactured demonstrations and is blind to the obvious mechanics of synthetic bedlam. The result is too often government by gullibility, propaganda, catchwords and slogans, instead of government by law based on facts, principles, intelligence and good will.

As President Stanley Hall once said, "man has not yet demonstrated that he can remain permanently civilized." Many thoughtful people have been led to question the ultimate effect of science upon civilization. We all recognize the utility of matches, but we keep them away from children. Meanwhile, science puts dynamite and T.N.T., poison gas, aeroplanes and motor cars at the disposal of criminals and the leaders of the mob. B. Russell, in "Icarus," sees in science the ultimate destroyer. Haldane, in "Daedalus," visualizes it as the stern and vigorous chastener and corrector which will ultimately save the race and usher in the new day of light and reason.

"Knowledge comes but wisdom lingers," and democracy levels down as well as up. Even in Boston cigars have replaced books on a corner famous for a century of literary associations. The world is wrong because few men can think. It will not be made right until those who can not think trust those who can. When its foundations are so obviously out of joint humanity still clings tenaciously to fossilized

precepts and opinions and is as resentful of suggested change as in the days of Galileo. Despite the pressure of new ideas, education must still, to be acceptable, follow old conventional lines.

Though we go from here to happy homes, let us not deceive ourselves. Human life is still a hard and fearsome thing. Mankind is required to maintain existence in a world in which, as Kipling has said, "any horror is credible." More than a hundred years ago De Quincey wrote, "We can die, but which of us, knowing as some of us do, what is human life, could, were he consciously called upon to do it, face, without shuddering, the hour of birth." But little more than yesterday Henry Adams closed his "Education" with the expression of the hope that perhaps some day, for the first time since man began his education among the carnivores, he would find a world that sensitive and timid natures could regard without a shudder.

Everywhere there is upheaval and unrest. "The machine," to quote Dr. Elton Mayo, "runs to an accompaniment of human reverie, human pessimism and sense of defeat."

We are everywhere overburdened by unnecessary illness, crushing taxation, extravagant and inefficient governments, huge expenditures for trivialities and the appalling waste of effort, material and resources. We are hampered by class suspicion and misunderstanding, racial antagonisms, the inhibitions of organized labor and the lack of imagination in high places. Life in general is on a low cultural plane and bound by custom and tradition.

One hundred years of science have failed to satisfy the cravings of humanity. Chesterton finds science "a thing on the outskirts of human life—it has nothing to do with the center of human life at all." We do not, of course, agree with him, but we must still meet the challenge of John Jay Chapman, who declares: "Science, which filled the air with so large a bray, is really a branch of domestic convenience, a department for the study of traction, cookery and wiring. The prophet-scientists have lived up to none of their prospectuses." The fault, however, as Wiggam points out, is not with science, nor with the scientists. It is with those who "have mainly used the immense spiritual enterprise of science to secure 5-cent fares, high wages and low freight rates," when it should have "ushered in a new humanism."

Thus we still encourage race-deterioration, still carry the burden of the unfit, still cultivate national antipathies, still are breeding from poor stock, and witnessing with equanimity the suppression of the best.

The history of aristocracies, feudalism, the church, the guilds and the soviets has amply demonstrated that no one class possesses the qualities required for the government of all classes, and we can not claim them for the Fifth Estate. We can, however, claim with full assurance that the Fifth Estate possesses many qualities, now practically ignored, which could be utilized in government to the incalculable advantage of us all. Its knowledge of material facts, of natural and economic laws, of the factors governing race development and human relations; its imagination, vision and its open mind should be brought to bear effectively in the formulation of national policies and the solution of governmental problems. There is an alternative before us, which has recently been defined with somewhat surprising frankness by Warren S. Stone, president of the Brotherhood of Locomotive Engineers, perhaps the most conservative of the labor unions. Mr. Stone says:

> But until labor, in the inclusive sense in which I am using it, secures control of legislative and executive branches of the national and state governments, and through control of the executive branch secures control of the judiciary, labor is in continuous peril or seeing its gains wiped out and its progress retarded, by hostile legislation or unfriendly court decisions.

Our countrymen may well consider whether they prefer participation in government by the Fifth Estate to the benefit of all or control of government by labor unions in the interest of labor.

Since most of the troubles that beset mankind have their origin in human nature it would seem worth the while of those who make our laws to study and apply the findings of the biologists and psychologists as to what human nature really is and the springs of its motivation.

Plato called democracy "the best form of bad government." It will be the best form of good government only as it develops the capacity to breed leaders and the faith to trust them. The quality of our children will determine the quality of our democracy. If our laws and mores and economic structure continue to discourage breeding from our best strains, if there is to be no adequate recompense for service of the higher types, the time is not far distant when democracy will no longer be safe for the world. If the Fifth Estate were everywhere to be wiped out, as it has been in Russia, the result would be vastly more calamitous than universal war.

Oswald Spengler, in a recent monumental work, forecasts the downfall of western civilization and would prove his thesis by the history of past cultures. But never in the past has man lived in so compact a world, never has he had such facilities for intercommunication with his fellows, never has he been endowed with such control of natural forces. He has

never known himself so well and, above all, never before has he had it in his power to direct so definitely the course of his own development. Our civilization is certainly imperiled, but there will be no downfall if mankind can be taught to follow the light already before it. As lantern bearers, it is the clear duty of the Fifth Estate to show the way. In the past the world has suffered grievously from lack of knowledge; to-day it suffers from its rejection or misapplication. Could the springs of human conduct and the affairs of peoples now be regulated only as wisely as we now know how there would be work and leisure and decent living for all. The criminal, the defective, the feeble-minded would be breeded out, and sane minds in sound bodies breeded in. The loss and suffering from preventable disease and accident would not be tolerated. Higher standards would govern the selection for the public service. Planning would replace *laissez-faire* development, and a rational conservation check the reckless waste of our resources. Production and distribution would attain to levels of efficiency altogether new, and the many injustices now existent in human relations would wellnigh disappear. With the reaction of a freed intelligence on politics, religion, morals we might hope for a broader tolerance, a better mutual understanding. With the recognition of the spirituality of science and the divinity of research and discovery should come larger interests and a new breadth of vision to the average man, and to us all acknowledgment of the steadfast purposive striving shown in the development of the created world and a reverent appreciation of man's privilege to aid and further this development.

We might reasonably expect ugliness to be replaced by beauty in our cities and small towns and later even in our homes. Government by intelligence for the general good of all should supersede government by special interests, blocs, faddists and fear of organized minorities and the uninformed crowd. With it all would come relief from the economic pressure, which bears so heavily upon the Fifth Estate that its children, which should be counted among the best assets of the community, are now a luxury.

The world needs most a new tolerance, a new understanding, an appreciation of the knowledge now at hand. For these it can look nowhere with such confidence as to the members of the Fifth Estate. Let us, therefore, recognize the obligation we are under. Ours is the duty and the privilege of bringing home to every man the wonders, the significance and the underlying harmony of the world in which we live.

ARTHUR D. LITTLE

JOHN MACLEAN—CHEMIST[1]

JOHN MACLEAN, M.D., the first professor of chemistry in the College of New Jersey (Princeton) and, according to Dr. Edgar F. Smith, one of the first chemists in the country at the close of the 18th century, was born in Glasgow, March 1, 1771, which made him a contemporary of Davy, Dalton, Priestley, Lavoisier, Berzelius, Avogadro and other very eminent chemists. His father, for whom he was named, was a surgeon of note, who was present at the capture of Quebec from the French, and he was the third man to scale the formidable heights of Abraham. His mother was Agnes Lang, of Glasgow.

While very young he lost both of his parents, whereupon George Macintosh, a gentleman of rare worth, became his guardian. It is of interest to note that he was the father of Charles Macintosh, F.R.S., a wealthy chemical manufacturer who invented the water-proof cloth.

Young Maclean received his early education at the Glasgow Grammar School and in the university, which he entered before he was 13 years of age, thus indicating that he was a precocious lad. This is borne out by the fact that he was awarded several premiums in school and in the university. It appears that he was much interested in the classics, particularly Latin, and in later years he wrote to his son, John Maclean, Jr., who became the tenth president of Princeton, as follows: "Be assured, that notwithstanding what ignorant and lazy people say, it is a matter of great consequence for every gentleman or professional man to be a good classical scholar."

At the university it is said that he gave close attention to chemistry, mathematics and natural philosophy, and especially to chemistry. In the 16th year of his age he joined the Chemical Society of Glasgow, before which he read at least seven papers, including one on *respiration,* another on *fermentation* and another on *alkalies.* Some of these papers contained suggestions in advance of the science of that day.

While at Glasgow Dr. Maclean also studied medicine and anatomy, for it was his purpose to become a surgeon. From Glasgow he went to Edinburgh, primarily, it may be presumed, to attend the chemical lectures of the celebrated Dr. Black. From Edinburgh he repaired to London and to Paris, where he had the best facilities for the study of chemistry and surgery. While a student at Paris, Lavoisier, Berthollet and other famous chemists were busy with their investigations, and Maclean was no doubt greatly impressed by them.

[1] A paper read before the Section of History of Chemistry at the 67th Meeting of the American Chemical Society, Washington, D. C., April 21 to 26, 1924.

After being absent from Glasgow about three years (1787–1790), he returned and resumed his studies for another year, and then engaged most successfully in the practice of his profession, continuing at the same time his researches in chemistry. In the 21st year of his age he became a member of the Faculty of Physicians and Surgeons of Glasgow University.

Being thoroughly in sympathy with the political sentiments of America, Dr. Maclean left Scotland in April, 1795, and arrived at New York the following month. From this city he went to Philadelphia, where he met Dr. Benjamin Rush, who advised him to go to Princeton. Acting upon this suggestion, he formed in Princeton a partnership with Dr. Ebenezer Stockton for the practice of physic and surgery. This partnership was soon dissolved, however, for Dr. Maclean was elected to a chair of chemistry in the College of New Jersey and he soon decided to devote his entire time to teaching.

It is of further interest to note that Dr. Maclean came to America the year after Priestley—the same year in which Lavoisier was beheaded. This was before Dalton and Avogadro had propounded their hypotheses, before Gay-Lussac had enunciated the law of gaseous volumes, and years before Berzelius introduced modern chemical symbols.

In the early summer of 1795, Dr. Maclean delivered in Nassau Hall a short course of lectures on chemistry, which made a favorable impression. On October 1, 1795, he was elected professor of chemistry and natural history; but the name of the chair was subsequently changed to "mathematics, natural philosophy and chemistry."

In 1797 his salary was 250 pounds ($666.66) per annum; and it was "ordered that chemistry and natural history be taught as branches of natural philosophy." The instruction in these branches was given only to juniors and seniors. Dr. Maclean taught at Princeton until 1812, and for several years his salary was $1,250 a year, together with the use of a college house.

Benjamin Silliman, M.D., the first professor of chemistry in Yale College, left in his diary the following statement:

> At this celebrated seat of learning (Princeton), an eminent gentleman, Dr. John Maclean, resided as professor of chemistry, etc. I early attained an introduction to him by correspondence, and he favored me with a list of books for the promotion of my studies. . . . I also passed a few days with Dr. Maclean in my different travels to and from Philadelphia, and obtained from him a general insight into my future occupation; inspected his library and apparatus, and obtained his advice respecting many things. Dr. Maclean was a man of brilliant mind, with all the acuteness of his native Scotland; and a sparkling wit gave variety to his conversation. I regard him as my earliest master in chemistry and Princeton as my starting point in that pursuit: although I had not an opportunity to attend lectures there.

Many years later Dr. Silliman revisited Princeton, and he said to President Maclean upon visiting the chemical laboratory: "It was in this room that I saw the first experiments in chemistry ever witnessed by me."

The younger Professor Silliman, of Yale, in a paper entitled "American contributions to chemistry," and read July 31, 1874, on the occasion of the Priestley Centennial, said: "Of the public seminaries of learning other than medical institutions where chemistry was taught from a separate chair, and as a distinct branch of the college curriculum of instruction prior to 1800, we find but one, and that distinction belongs to Nassau Hall, Princeton, New Jersey."

It should be stated in this connection, however, that James Hutchinson and Dr. James Woodhouse of the University of Pennsylvania, Aaron Dexter of Harvard, and Dr. Samuel Mitchell of Columbia were contemporaries of Maclean, and taught more or less chemistry at a very early date in those institutions; but the speaker is unable to state just when chemistry was taught in those institutions "from a separate chair, and as a distinct branch of the college curriculum." From Dr. Silliman's paper just referred to, I also beg to quote as follows:

> Dr. Maclean ever deserves honorable mention as one of the earliest and most successful teachers of our science in this country. . . . In Paris Dr. Maclean learned to admire the antiphlogistic theory, as the "new chemistry" of Lavoisier was called, and which he taught and defended at Princeton. In 1795 he published "Two lectures on chemistry, read at Nassau Hall, containing an examination of Dr. Priestley's consideration on the doctrine of phlogiston and the decomposition of water." These lectures display both ability and learning and form an interesting chapter in the history of phlogistic discussion.
>
> Dr. Maclean contributed several articles to the New York *Medical Repository*, and his name is associated with that of Professor Silliman in editing the first American edition of Henry's "Chemistry," in 1808.

The speaker has been fortunate enough to find in the Library of Princeton University a notebook on chemistry by John Eager Howard, Jr.,[2] of Baltimore, bearing the date of 1806. Howard was a pupil of Dr. Maclean, and his notes are very full and beautifully written. Apparently they are a transcript of Dr. Maclean's lectures. In these notes we find the topics

[2] John Eager Howard, Jr., was a son of General John Eager Howard, and a grandson of Justice Chew. He graduated at Princeton in 1806 and was at one time a member of Congress.

discussed by the lecturer. The following statements are taken from this notebook:

Chemistry is the investigation of those intimate and mutual actions of bodies on each other, by which their properties are altered, or their individuality destroyed. . . .

Matter may be divided into dead and living. Of dead substances some are simple and others compound. The simple are those whose composition is unknown, and the compound are such as have been analyzed into simpler parts. The substances which, according to the above definitions, may be considered as simple are:

caloric	silex	fluoric acid	antimony
light	alumine	boracic acid	mercury
electricity	magnesia	arsenic	zinc
oxygene	lime	tungstein	tin
azote	barytes	cobalt	lead
hydrogene	strontites	malybdena	copper
sulphur	pot-ash	bismuth	silver
phosphorus	soda	nickel	gold
carbone	muriatic acid	manganese	platina

There are 37 of these "simple substances," which constitute the titles of so many chapters in the notebook. 17 of these were regarded as metals, which were divided into semi-metals (brittle) and metals.

Dr. Maclean also gave a second course in chemistry, which had to do with *living* or *animated bodies*. This was a much shorter course, dealing with the structure and organization of vegetables, vegetable productions, fixed gross or fat oils, volatile oils, the composition of vegetables and tanning and currying.

It thus appears that Dr. Maclean gave attention to the relation of chemistry to agriculture and manufactures as well as to medicine.

Finally, Dr. Maclean resigned at Princeton in 1812 to accept the chair of chemistry in William and Mary College. He spent a year at Williamsburgh; but, being in poor health, he returned to Princeton at the close of the college year, where he died February 17, 1814, and two days later he was buried in the so-called "Westminster Abbey of America," his grave being contiguous to those of the college presidents and professors, and where all who still come and go may read the following extract taken from the Latin inscription on his tomb: "Exceedingly beloved and esteemed by the professors and youth of the college, he departed this life lamented by all."

WILLIAM FOSTER
PRINCETON UNIVERSITY

GEOLOGICAL FEATURES OF CITY PARKS

As a result of the request of the Committee on the Features of City Parks appointed by the American Association for the Advancement of Science a little over a year ago the following announcement was made March 26, 1924:

From 35 writers encouraging reports were received. Most of them stated that a beginning had been made in the way of conferences; a few told that work had been begun; two, Pittsburgh, Pennsylvania, and St. Joseph, Missouri, reported good progress; and Hartford, Connecticut, announced a completed task, in the way of selecting, clearing and marking a good number of geological features in that city.

Because Hartford and Trinity College were the first to report work completed along the lines suggested by the committee, Professor Davis, its chairman, has asked me to make a statement concerning our endeavors.

At the time of the 1923 centennial celebration of Trinity College there was published a special number of the *Trinity College Bulletin,* setting forth in description, photographs and diagrams the principal features of the rocks of the campus and the adjacent Rocky Ridge Park. Although this was not precisely what the committee wanted (except for some excavating which had been done to expose glacial grooves) yet the work in preparing the bulletin furnished the happy background, and it was an easy matter and a next logical step forward to place signs here and there to designate the chief features which had been observed.

Ten signs were put on the campus and in the park. Three of them were large printed labels, under glass, located near the entrances or at other especially important positions and each shows a diagram of the whole area with the locations of all the stations, a main text or summary of the general geological features, on one side three block diagrams representing the structure in its stages of development and on the other a description and photograph of the particular feature which the sign is intended to explain.

In addition to the large signs there are seven small ones each with a brief inscription painted on wood: one calls attention to some "grooves at your feet made 100,000 years ago by the glacier," another is near a huge glacial boulder, another marks the contact between the trap rock and sandstone, and so on for the seven.

So far as the classes in geology are concerned the rocks of the campus and park have furnished us a veritable museum and laboratory for the study of earth phenomena. The structure is well shown and is typical of the whole Connecticut Valley. Besides the major rift represented by the Rocky Ridge itself, so well known to geologists, there is a small clear-cut fault with a throw of about four feet; the fault zone presents slickensides, breccia and dragging; the fault surface is marked by a thick vein of white barite with a half dozen other minerals. The red sandstone and trap rocks have much of interest; the physiographic features illustrate many of the prin-

ciples we are studying in our courses; there is abundant evidence of glaciation.

The signs have helped in the instruction of the scientific students, but evidently they had a wider need.

From the standpoint of the people of the city who chance to pass through the park the signs have been a revelation; they have made the cliffs something more than the barrier to their progress across the city. Several letters have come in expressing delight at the offer of a solution to the "riddle of the rocks," and the simple explanation of what had generally been ascribed in a vague way to "an upheaval of some sort."

It was gratifying indeed to see the enthusiasm, almost eagerness, with which the city and college authorities took up the task and carried it through. Great credit is due President Ogilby of Trinity College, Professor Perkins, commissioner for Rocky Ridge Park, and Mr. Parker, chairman of the city park board.

Edward L. Troxell

Trinity College,
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SCIENTIFIC EVENTS

THE ORGANIZATION OF TEACHING IN THE UNIVERSITY OF CAMBRIDGE[1]

The University Commissioners appointed in accordance with the recommendations of the Royal Commission regarding the organization of teaching in the University of Cambridge have, after considering the representations made to them, sent a memorandum to the vice-chancellor embodying the following scheme:

Faculties.—Under the scheme, which it is proposed to bring into force on October 1, 1926, there would be faculties, faculty boards and a general board of studies. All fees for lectures announced by the general board of studies would be paid to the university.

There would be eighteen faculties, arranged in two groups—arts and science. In the arts group there would be eleven faculties and in the science group seven. In the latter, however, the faculty of biological studies would be divided into two departments, the one containing four sections and the other six. The departments in the second section of the faculty of biological studies would be biochemistry, experimental psychology, human anatomy, parasitology, pathology and physiology. The faculties would be composed of professors, readers, university lecturers, fellows of colleges giving lectures or demonstrations and a certain proportion of other persons appointed by the board of the faculty.

Medicine would be one of the faculties in the science group. It would consist of teachers who come within one of the classes above mentioned, and give instruction in medicine, surgery, pharmacology, anatomy, biochemistry, physiology or pathology, or give courses in physics, chemistry or biology for medical students.

The faculty boards would consist of the professors, a certain number of members of the faculty elected by it for a period of four years, a certain number of persons nominated by the council of the senate for a period of two years, a certain number nominated by the board, and in certain cases representatives of cognate studies.

The Faculty Board of Medicine would consist of the Regius professor of physics, the Downing professor of medicine, the professors of anatomy, biochemistry, pathology and physiology, four members of the faculty elected by it, and two persons nominated by the council.

General Board of Studies.—The suggestion of the commissioners is that the general board of studies should consist of the vice-chancellor, of four members each of the groups of arts and science faculties, respectively, four members of the council of the senate and two persons not members of the council of the senate elected by the university for four years. It is proposed to transfer the present duties of the general board in regard to the awarding of the higher degrees to the board of research studies.

University Lectureships.—The commissioners suggest certain regulations for university lectureships (including demonstratorships). Lecturers would be appointed by a standing committee separately constituted for the faculty or department. This committee would consist of the vice-chancellor, the head of the department, three members of the board of the faculty and two persons nominated by the general board.

Tenure.—Appointments would, as a rule, be made in the first place for three years, but on reappointment tenure would be for so long as the lecturer continued satisfactorily to perform the duties of his office until the retiring age. The faculty board is to ensure that professors, readers and lecturers continue to perform the duties of their office satisfactorily.

Work and Salaries.—The passage from the report under this head is as follows: "The Commissioners think it will be impossible to ensure absolute equality between the conditions of work and remuneration in the various faculties. Their present opinion is that there should be a basic amount of teaching work obligatory upon a university lecturer—namely, not fewer than thirty-two or more than forty-eight hours of lecturing during the year. That the initial basic salary given in respect of such amount of work be not less than £160. That the general board should have authority to vary in specific cases the requirements as to the basic amount of teaching work. That each faculty should have a scale of increments in the basic salary to be approved by the general board, and that other payments in addition to the basic salary should be made in consideration of work done in addition to the basic amount of work. That boards of faculties should have power to make a maximum additional payment of £250 a year to a university lecturer who is not a fellow of a college. That the payments to be made to university lecturers in addition to the basic salary should be deter-

[1] From the *British Medical Journal.*

mined by the faculty board concerned and made from faculty or departmental funds. These funds will consist of (1) fees for lectures, including lectures given by professors and readers, (2) contributions from the chest."

Retiring Age.—The commissioners recommend that the retiring age for all members of the university teaching and administrative staffs shall be 65, but contemplate that the general board would have power to continue a professor in office for a period not exceeding five years—that is, until he attains the age of 70.

Position of Women in Relation to Teaching.—The commissioners contemplate that the statutes will be so framed as to render women eligible for professorships, readerships, university lectureships and examinerships, subject to the reservations made by the Royal Commission. Fellows of women's colleges will be eligible to become members of faculties.

CANADA'S WATER POWER AND MINING INDUSTRIES

A BULLETIN has been issued by the water power branch of the Canadian government on the effect of the plentiful water power on the future developments of the mining industry which states that the theory is often advanced that Canada is likely to become the leading mineral-producing country of the world, and considerable ground for this assumption is found in the fact that the Dominion contains 16 per cent. of the world's known coal resources, has greater asbestos, nickel and cobalt deposits than any other country and ranks third in the production of gold, while the diversity of her mineral endowment is indicated by the fact that the three main divisions—metallic, non-metallic and structural and clay products—include some sixty principal items, seventeen of which had a production value of $1,000,000 or over for each in 1923.

The best conception of the value of the output may be given by stating that the lowest since 1910 was $103,221,000 for 1911, and the highest was in 1920, when the valuation of $227,860,000 was reached, the average value being $194,957,000 for the five-year period. As the commodity prices reached a peak in 1920, and have since receded, production computed in terms of value is not a fair basis for comparison. An index showing the volume of production by weight would undoubtedly mark 1923 as the banner year in Canada's mineral industry, since new output records were established last year for coal, lead, zinc, asbestos and for the value of cobalt produced.

The principal uses of power in mining are for compressed air for drilling, driving motors for hoisting, haulage of ore above and below ground, driving ore crushers and conveyers, pumping water for the water supply and removing it when it accumulates below ground, lighting, heating, ventilating, signaling, for machine shops and for various electrical-metallurgical processes. Even in the comparatively simple method employed in the recovery of coal as much as 10 per cent. of the product may be consumed in generating the necessary power.

The bulletin states that the Dominion Water Power Branch has computed that on January 1 last the hydraulic installation for mining purpose in the Dominion had reached a total of 277,600 horsepower, of which 233,200 horsepower was purchased from central electric stations. It is estimated that the capital investment necessary to develop this power was £74,000,000.

From the point of view of minerals and the development of mining Canada is divided into five main areas, which consist of the Maritime Provinces, Quebec, Ontario, the Prairie Provinces and British Columbia and the Yukon. Each of these possesses large resources for water power, already developed or available. With the exception of some of the coal fields of the central plain there is no area for which ample water power can not be supplied.

The department's latest table of available and developed water power in Canada, dated February 1, shows there is a total available twenty-four-hour power, at 80 per cent. efficiency, of 18,225,316 horsepower at ordinary minimum flow and 32,075,998 horsepower at ordinary six months flow, and a total turbine installation in Canada of 3,227,414 horsepower. The table shows the fortunate distribution of water power throughout the Dominion. The two provinces without native coal, Ontario and Quebec, lead in the possession and utilization of water power, followed closely by Manitoba, where only lignite coal is found.

LOWELL INSTITUTE LECTURES FOR 1924–25

NINE courses of free public lectures treating upon diverse subjects, including politics, history, meteorology, geology and science, are announced by the Lowell Institute of Boston, for the season which will begin about the middle of October and continue through March.

Of the lecturers four are from Harvard, one from Princeton and four from England. The British visitors are to be Rt. Hon. Herbert Fisher, M.P., former minister of education and British delegate to the first three assemblies of the League of Nations, who will speak on "The aftermath of war"; Dr. A. J. Carlysle, of Oxford, on "The medieval political theory and the principles of modern political organization"; General Sir Frederick Maurice on "Robert Lee, the soldier," and Professor William George Stewart Adams, of Oxford University, on "Idealism and realism in politics." Dr. Dana Carleton Munro, pro-

fessor of medieval history at Princeton University, has taken for his subject, "The Latin Kingdom of Jerusalem," and will trace its development and decline in eight lectures. Dr. Alexander McAdie, professor of meteorology at Harvard and director of the Blue Hill Observatory, is to speak on "The weather in peace and in war." Another Harvard man, Dr. Reginald A. Daly, chairman of the department of geology and geography, will follow Dr. McAdie with a course on "Our mobile earth." The other two lecturers from Harvard are Dr. Alfred North Whitehead, professor of philosophy, whose eight lectures will be on "Science of the modern world," and Dr. Walter Fenno Dearborn, professor of education, who will discuss in eight lectures "Intelligence tests, their significance and implications."

The subjects of the lectures by Dr. McAdie, Dr. Daly and Dr. Whitehead are as follows:

Our Mobile Earth

A course of eight lectures by Reginald A. Daly, Ph.D., S.D., chairman of the Department of Geology and Geography, Harvard University, to be given Mondays and Thursdays at eight o'clock in the evening, beginning Monday, January 5.

1.—Great earthquakes of history.
2.—Seismology, the science of earthquakes.
3.—Nature of the earth's interior.
4.—Mechanism of volcanic action.
5.—Distortion of the earth. Warping of the continents. Distribution of land and sea in past time.
6.—Mountain ranges. Location, kinds, ages.
7.—Mountain ranges. Origin of structure and form.
8.—Evolution of the face of the earth.

The Weather in Peace and War

A course of six lectures by Dr. Alexander McAdie, A. Lawrence Rotch professor of meteorology in Harvard University and director of the Blue Hill Observatory, to be given Mondays and Thursdays at eight o'clock in the evening, beginning Monday, December 1.

1.—Present knowledge of the atmosphere, especially results of recent soundings.
2.—Clouds and water vapor in the free air.
3.—Lightning and other manifestations of atmospheric electricity.
4.—Droughts, floods and seasonal forecasts.
5.—The strategy of weather in war.
6.—Aerography in the arts and sciences.

Science and the Modern World

A course of eight lectures by Dr. Alfred North Whitehead, professor of philosophy in Harvard University, to be given on Mondays and Thursdays at five o'clock in the afternoon, beginning Monday, February 2.

1.—Science and modern civilization. Birth of modern science. Classical and medieval antecedents. Evolution of the scientific mentality from medieval law, theology and art.
2.—Science of the seventeenth century. Galileo to Newton. Bacon, Descartes, Leibnitz. Man and nature. The fundamental generalizations.
3.—The eighteenth century and the "victorious analysis." Triumph of Newtonian dynamics. Materialism and empiricism. Prevalence of Greco-Roman influence over that of earlier Greek thought. Rational despots and aristocracies.
4.—Science and literature. Pope, Wadsworth, Shelley, Tolstoy, Ibsen, Bernard Shaw. Science and the Greek conception of fate.
5.—Civilization and technology. Energy, its conservation and utilization. Sociology and speed. Biology and racial development. From picture-writing to broadcasting. Instrumental design. The nineteenth century.
6.—Modern thought. Collapse of the eighteenth century settlement. From matter to electricity. Continuity and atomism. Relativity. Hypotheses.
7.—Science, religion and philosophy. From Locke to Bergson. From Galileo to Darwin. The eternal and the transitory. Tradition and progress.
8.—Science and education. The places of logic, science, literature, art, knowledge, enjoyment, genius, patriotism and world-citizenship.

THE MILTON FUND FOR RESEARCH OF HARVARD UNIVERSITY

President A. Lawrence Lowell, of Harvard University, has made the following statement regarding the bequest left by the late William F. Milton:

The late William F. Milton left the bulk of his estate to his wife for life, and after her death to Harvard University for the purpose, first, of building a library if the university had no suitable library building, and then "If said fund is not used in constructing and erecting such library building, or if a part thereof remains after such construction, I then hereby authorize and empower said President and Fellows of Harvard College to use the *income* of said fund, or such *income* thereof as remains after constructing said library building, from time to time, either in whole or in part, to defray the expenses of any special investigation of a medical, geographical, historical or scientific nature which said Corporation may from time to time desire to make or prosecute in the interests of, or for promoting the physical and material welfare and prosperity of the human race, or to assist in the discovery and perfecting of any special means of alleviating or curing human disease, or to investigate and determine the value or importance of any discovery or invention, or for any other special or temporary object of the nature above stated. . . ." The legacy has now been received by the university, and is expected to yield an income of about $50,000. The provisional arrangement for its use in the immediate future is as follows:

The Corporation will be glad to receive from any member of the instructing or scientific or administrative staff of the university requests for aid in investigation. Such requests must be received before December 1 next, and must specify the object and nature of the investigation with as much precision as is necessary to judge of its value, the probable length of time it will require, and the expense involved; this last item to include the salary for the proportion of time to be transferred from other duties. The Corporation will appoint each year a committee to advise it in making a selection among the investigations proposed, and in the allotment of income therefor. No allotments will be made for more than two years; but if an investigation proves to require a longer period, the grant may be renewed.

SCIENTIFIC NOTES AND NEWS

THE centennial celebration of the Rensselaer Polytechnic Institute opens at Troy, New York, on October 3. The program, printed in SCIENCE for August 29, contains the names of a large number of official delegates from educational institutions, scientific organizations and engineering societies throughout the world, including the following from abroad who will give addresses: President Sir Charles Langbridge Morgan, of the Institute of Civil Engineers of Great Britain; President Henri Abraham, of the Society of Electrical Engineers of France; President Luigi Luiggi, of the Society of Civil Engineers of Italy; Honorary President Roberto Gayol, of the Society of Engineers of Mexico; President Arthur Surveyer, of the Engineering Institute of Canada.

EXERCISES formally inaugurating the Boyce Thompson Institute of Plant Research at Yonkers, New York, took place on September 24 with Dr. John M. Coulter, professor of botany at the University of Chicago, presiding.

DR. HARVEY CUSHING, professor of surgery at the Harvard Medical School and surgeon-in-chief of the Peter Bent Brigham Hospital, Boston, will deliver the dedication address at the opening of the new school of medicine of Western Reserve University on October 9.

DR. S. P. L. SÖRENSEN, of the Carlsberg Laboratories, Copenhagen, Denmark, lectures before the first regular meeting of the New York Section of the American Chemical Society on the evening of October 3, his subject being "The heat of coagulation of proteins." On the following evening, October 4, Professor Sörensen will deliver the first Harvey Society Lecture at the New York Academy of Medicine, on "The solubility of proteins."

THE recent award by the Paris Academy of Sciences of le prix Saintour to Lee deForest was made with the following citation: "inventeur de la lampe a trois electrodes pour les perfectionnements apportés par lui dans la technique des ondes hertziennes qui ont rendu possible la telephonie sans fil."

DR. KOTARO HUNDA, of the Imperial University, Japan, was made an honorary member of the American Society of Steel Treating at the recent meeting in Boston.

PRESIDENT LUIGI LUIGGI, of the Society of Civil Engineers of Italy, who is visiting the United States on the invitation of the Rensselaer Institute of Technology, was the guest of honor at a luncheon, given by the Italy-American Society at the Bankers' Club, New York City, on September 24.

DR. CHARLES TODD, technical expert to the Egyptian Department of Public Health, has had conferred upon him the insignia of the Second Class of the Order of the Nile by the King of Egypt in recognition of valuable services rendered.

ADDITIONS to the Harvard Observatory include Dr. Georges Lemaitre, of the University of Louvain, Belgium, who will join the staff for a year. Professor B. Gerasimovic, senior observer at the university observatory of Kharkow, Ukraine, will spend some months at the observatory on astrophysical investigations, and Paul Davidovich, of Turkestan and Moscow, also will be at the observatory for part of the year to make investigations.

PROFESSOR DONALD BRUCE has resigned from the University of California to accept the position of chief of forest mensuration with the Forest Service at Washington, D. C.

THE Cushman fellowship in Western Reserve University, recently founded through a gift from the Ferro Enameling Co., has been awarded to Howard Williams, of Ohio.

DR. OTTO HAHN, member of the Kaiser-Wilhelm Institute of Chemistry, has been appointed director of the institute.

THE eighty-fifth birthday of Professor B. Naunyn was celebrated recently. He is still continuing his research on diabetes and gallstones, although he retired from academic work in 1904. He is soon to publish a volume of reminiscences.

DR. OSCAR BREFELD, professor of botany at the University of Breslau and known for his work on mushrooms, has celebrated his eighty-fifth birthday.

DR. A. B. COX, agricultural economist of the Department of Agriculture, is leaving for a year's study in England, Germany, France and Italy of cotton marketing methods, supply, demand and prices.

SIR WILLIAM JONES, chairman of the research committee of the British Refractories Association, is now on a visit to the United States.

DR. JEANNENEY, of Bordeaux, France, is visiting the United States for the purpose of studying our methods of dealing with the cancer problem.

CAPTAIN RASMUSSEN, the explorer, has left Nome in the schooner *Teddy Bear* to study the Siberian Eskimo tribes. Having visited all the Eskimos from Greenland to Nome he desires to complete his observations by visiting the Siberian tribes.

DR. M. A. CHRYSLER, of the department of botany of Rutgers University, spent part of August and September in western Cuba and southern Florida. The endemic Cuban cycad *Microcycas* was the particular object of search.

SIR JOHN RUSSELL, director of the Rothamsted Experimental Station, England, gave the Hitchcock lectures for the season of 1924–25 at the University of California. His subjects were: "The discovery of the food of plants." "Modern problems in plant growth: can science solve them?" "Decay and the living plant, 'Mors juana vitae.'" "The soil organisms: can they be controlled and utilized?" "The soil and the growing plant."

JULIAN S. HUXLEY, of Oxford University, will give a course of six lectures on some aspects of evolutionary biology at the New School for Social Research, New York, from October 8 to 24.

DR. EDMUND OTIS HOVEY, curator of the department of geology and invertebrate paleontology of the American Museum of Natural History, long secretary of the American Geological Society, died on September 26, aged sixty-two years.

DR. JOHN LORENZO HEFFRON, dean emeritus of the College of Medicine of Syracuse University, died on September 28, as the result of injuries received in an automobile accident. Dr. Heffron was seventy-three years old.

BERNARD H. RAWL, former assistant chief of the Dairy Division of the United States Department of Agriculture, died on September 23 at the age of forty-eight years.

DR. RANDOLPH BRYAN CARMICHAEL, professor of dermatology at the George Washington University Medical School, died on September 3, aged fifty-five years.

PROFESSOR KARL BRICK, member and scientific collaborator of the Hamburg Institute for Applied Botany, has died, aged sixty-two years.

THE following awards for 1924–25 have been made by the Salters' Institute of Industrial Chemistry, England: Fellowships are renewed to Dr. W. G. Sedgwick, Armstrong College, Newcastle-on-Tyne, and Oxford, Fellow, 1923–24, and to Mr. W. Randerson, Imperial College of Science and Technology, Fellow, 1922–23, and Hon. Fellow, 1923–24 (during tenure of Albert Kahn Travelling Fellowship). Fellowships are awarded to Mr. H. H. Evers, University of Liverpool; Mr. K. Knight Law, University College, Nottingham; Mr. H. S. Pink, University College, Nottingham, and Oxford, and Mr. V. E. Yarsley, Birmingham University. The Salters' Institute has also awarded 72 grants-in-aid to young men and women, employed in chemical works in and near London, to facilitate their further studies.

THE regular fall meeting of the Executive Committee of the American Association for the Advancement of Science will occur at the Cosmos Club in Washington on Sunday, October 12. Letters and memoranda concerning association matters to be brought before the committee should be in the hands of the permanent secretary not later than October 10.

THE eighteenth annual convention of the Illuminating Engineering Society will be held at Briarcliff Lodge, Briarcliff Manor, New York, from October 27 to 30.

AT the twenty-first annual meeting of the American Roentgen Ray Society held at Swampscott, Mass., from September 3 to 6, the following officers were elected for the ensuing year: *President,* Dr. George A. Groover, of Washington; *Secretary,* Dr. Charles L. Martin, of Dallas, Texas; *Treasurer,* Dr. W. A. Evans, of Detroit, reelected.

THE *Journal* of the American Medical Association reports that the Fifth Biology Reunion convened at the medical school in the City of Mexico on July 21, and continued for several days. Dr. Fernando Ocaranza, president of the Mexican Biological Society, opened the proceedings and spoke later on "Poisoning from scorpion stings" and "Mexican publications on physiology." Professor I. Ochoterena discussed neurologic questions, especially "The dual innervation of striped muscles," and Dr. I. González Guzman the "Technic of postvitam staining" and the "Differential blood count." Among the other speakers, Dr. T. G. Perrin described cancer of endocrine organs and Drs. Cervantes and Varela their experiences with testis implants.

OFFICERS elected at the eighteenth annual convention of the International Association of Game, Fish and Conservation Commissioners at Quebec are: J. Harkin, Ottawa, *president*; John S. Phillips, Pittsburgh, *first vice-president*; F. C. Walker, Hartford, Conn., *second vice-president*; R. P. Pollard, New York, *secretary-treasurer,* and Guy Amsler, Little Rock, Ark., *general manager.*

ARRANGEMENTS are being made for an International Congress of Radiology in London next summer. It is proposed that the congress shall be opened on

June 30, and continue for four days of two sessions each, and that visits shall afterwards be paid to provincial centers. The administrative and social center of the congress will be at the house of the British Institute of Radiology in Welbeck Street.

ACCORDING to the *British Medical Journal* the annual general meeting and conference of the Institute of Industrial Welfare Workers was held at Swanwick, Derbyshire, from September 26 to 29. The subject of the conference was "The doctor and the psychologist in industry." Dr. C. S. Myers, director of the Institute of Industrial Psychology, spoke on the subject of "What psychology can do for industry," and was followed by Dr. W. F. Dearden, honorary secretary of the Association of Certifying Factory Surgeons, who dealt with the subject of "What medical science can do for industry." "The psychological and physiological aspects of accident prevention" was discussed by Dr. Millais Culpin and Dr. H. M. Vernon, investigator for the Industrial Fatigue Research Board.

THE American Institute of Chemical Engineers has received an invitation from Sir Arthur Duckham, president of the Institution of Chemical Engineers (England), to hold a joint meeting in England in July, 1925, following the Providence meeting of the American organization. The secretary is now canvassing the members to see whether a sufficient number would attend a meeting in England to make a joint session successful.

DR. A. W. GILBERT, Massachusetts Commissioner of Agriculture, has announced plans for bringing together world leaders in all lines of agriculture at some American university next July, for a month's school of instruction and discussion of problems of cooperation in agriculture. Dr. Gilbert is chairman of the committee that will arrange for the meeting.

ITALY'S National Exhibition of Pure and Applied Chemistry, which was to have been held this fall at Turin, has been postponed until spring. It was found that the task of assembling the exhibits was greater than had been estimated. Because of the postponement, however, the scope of the exhibition will be expanded.

THE Iowa Child Welfare Research Station has received a bequest of $10,000 in the will of the late Cora B. Hillis, of Des Moines, Iowa.

THE establishment in Philadelphia of a technical research bureau to investigate the problems of dyeing, yarn testing, designing and other details of production has been approved at the annual convention of the National Knitted Outerwear Association.

THE University of Colorado has received a gift of $5,000 and an assured income of $1,000 a year for the purchase of books in medical research, from Mrs. Charles Denison, of Denver.

SELECTION of Portland, Ore., for the new northwest reforestation experiment station has been recommended by E. H. Clapp, assistant forester in charge of research at Washington, D. C. The new station will be the center of the most extensive forestry experimental work in the United States. Study will extend to problems on private timber holdings as well as on the national forest areas, and will include growth of trees, protection of young trees from fire and methods of cutting and brush burning to insure reforestation. All the leading timber of the northwest will be served from the Portland office, if the recommendation is accepted.

A NATIONAL Cancer Institute at Lima, Peru, was inaugurated recently by the president of the republic. Dr. Eladio Lanatta, a local physician, who has been making a special study of radiography in the United States, has been placed in charge of the new institution.

UNIVERSITY AND EDUCATIONAL NOTES

DRURY COLLEGE, Springfield, Missouri, has received $100,000 from an anonymous donor.

BY the will of the late Mrs. N. F. McCormick, Tusculum College, Tennessee, will receive $100,000, Princeton University $20,000 and the Allahabad Agricultural Institute of India $3,500.

FOUR new buildings become available at Ohio State University with the opening of the fall quarter. The buildings represent an expenditure of more than $1,000,000 and include a new administration building, commerce building, Hamilton Hall and the journalism building.

FUH TAN UNIVERSITY, Kiangwan (Shanghai), China, has been given $100,000 for a psychology building. The building is to be of stone, three stories high, 50 ft. by 120 ft. Dr. Zing Yang Kuo, who was trained in psychology at Columbia University and the University of California, is head of the department of psychology at Fuh Tan University.

DR. LEMUEL H. MURLIN, for thirteen years president of Boston University, has accepted the position of president of DePauw University, Indiana.

THE trustees of Worcester Polytechnic Institute have offered the presidency of the institution to Rear Admiral Ralph Earle to succeed Dr. Ira N. Hollis, who handed in his resignation two years ago to take effect on the choice of a successor.

At the University of Kansas Dr. Dinsmore Alter, formerly associate professor of astronomy, has been appointed professor of astronomy in the department of physics and astronomy. He spent the past academic year in study and research in the California Institute of Technology while on leave of absence from the University of Kansas.

Professor William J. Miller has resigned as head of the department of geology in Smith College to become professor of geology and chairman of the department in the University of California, Southern Branch, Los Angeles.

Dr. Shepherd Ivory Franz has resigned his positions at St. Elizabeths Hospital and George Washington University and will be associated with the department of psychology of the University of California, Southern Branch, Los Angeles.

At the University of South Carolina Dr. Laurence L. Smith has been appointed associate professor of geology and Mr. Fred R. Neumann instructor in geology.

Dr. George N. Bauer has been appointed associate professor of mathematics at the University of New Hampshire.

Dr. H. W. Rickett, instructor in botany at the University of Wisconsin, has been appointed assistant professor of botany at the University of Missouri.

At a recent meeting of the Board of Regents of the University of Nebraska, the following appointments to the College of Medicine were confirmed: Dr. Harold Gifford, professor of ophthalmology, emeritus; Dr. James M. Patton, professor of ophthalmology and chairman of department; Dr. O. M. Cope, assistant professor of physiology and pharmacology; Dr. Herman F. Johnson, clinical assistant in orthopedic surgery; Dr. A. R. Knode, secretary of the department of laryngology; Dr. Chas. F. Moon, instructor of obstetrics and gynecology; Dr. A. E. Bennett, clinical assistant in neurology; Dr. M. Grodinsky, clinical assistant in surgery; Dr. Walter Benthack, fellow in pathology. The regents also created the department of clinical investigation and Dr. Arthur D. Dunn was appointed professor and chairman of this department.

Sir Gilbert Walker has been appointed professor of meteorology at the Imperial College of Science, England, in succession to Sir Napier Shaw.

Dr. Wilhelm Stepp, professor of internal medicine at the University of Giessen, who is doing research work at Baltimore, has been appointed professor at the University of Jena following the resignation of Professor Stintzings.

DISCUSSION AND CORRESPONDENCE

THE PRESSURE CAUSED BY A FLAME

Professor Carl Barus[1] has recently described observations of what he at first took to be a pressure caused by the burning of the gas in an open flame, but which he now thinks is probably due to the increased viscosity of the heated gas near the point where it escapes from the orifice into the flame. This effect is one which I ran across a number of years ago,[2] and which at that time I attributed to a real pressure exerted by the flame.

My method was entirely different from that used by Professor Barus. I was feeding a small flame with gas from a small gasometer, and I noticed that when the flame was extinguished the gasometer bell fell more rapidly than when the flame was burning. The effect was the same as if the movement of the burning gas away from the point where it burned gave rise to a pressure.

Since Professor Barus's note appeared I have looked again for this effect, and in a couple of cases have examined roughly the magnitude of the effective back pressure. The gas was ordinary illuminating gas, and the nozzle at which the flame burned was a piece of glass tubing about 6 mm in inside diameter, drawn down at one end until the opening through which the gas escaped had a diameter of a little less than a millimeter. A number of readings of the height of the gasometer bell, taken while it was falling, showed that its rate of fall was nearly linear. The difference between the rate of fall when the flame is burning and when it is not burning may be surprisingly large. The following table shows the difference for two cases. It will be seen that when the gas was not

Condition	Rate of Fall, mm/sec.	
	Case 1	Case 2
Burning	0.084	0.140
Not Burning	0.126	0.189
Burning Again .	0.082	0.141

burning the bell of the gasometer fell in the first case half again as fast as when the gas was burning. That is, in some way the burning slowed down the fall of the gasometer, as if the movement of the burning gas away from the point where it burned produced a pressure.

To get some idea as to the magnitude of this apparent pressure it is only necessary to reduce the load on the bell of the gasometer until the rate of fall when the gas is not burning equals the rate observed

[1] Science, 60, p. 137, August 8, 1924.

[2] Acoustic Repulsion of Jets of Gas, p. 29, Clark University Dissertation, 1913.

when the gas is burning. From the reduction in the load and the diameter of the bell the effective flame pressure can be obtained. My values are rough, but for the two cases shown in the above table they turn out to be about 0.18 mm of mercury and 0.37 mm of mercury. These are of the same order of magnitude as the values given by Professor Barus.

The question as to whether the effect is due entirely to the increased viscosity of the heated gas, or whether a true flame pressure has also something to do with it, is not easily answered. The observations reported by Professor Barus seem to indicate that the viscosity is important. A rough analysis of various factors which are involved suggests that for a given orifice the added pressure caused by the increased viscosity would be roughly proportional to the rate of efflux, and that a true flame pressure would also be roughly proportional to the rate of efflux. In the two cases cited above the ratio of the added pressures which were observed is 2.1, whereas the ratio of the rates of efflux is 1.7. These numbers differ sufficiently to suggest that perhaps neither factor alone is sufficient to explain the pressure but that both may be operative, that the added pressure may perhaps be due in part to the increased viscosity and also in part to a true flame pressure.

ARTHUR TABER JONES
SMITH COLLEGE

TO TEACHERS OF LABORATORY GENETICS

ASIDE from the now ubiquitous Drosophila, suitable material for laboratory work in genetics is not abundant. Occasionally in our research laboratories, forms are secured which are favorable for use in illustrating one or another fundamental genetical principle, and such material should be brought to the attention of teachers and made available for general use in teaching laboratories.

Cases in which dominance is definitely absent, giving rise to the monohybrid ratio 1 : 2 : 1, are relatively rare, and the classical examples of the Blue Andalusian fowl and the pink-flowered Mirabilis are not suitable for laboratory use.

Since the occurrence of dominance introduces a complicating factor in the analysis of hybrid progenies because it masks genotypic differences, destroying the parallel between the phenotype and the genotype, the 1 : 2 : 1 ratio gives a simpler approach to the typical Mendelian behavior than does the 3 : 1 ratio of the much more common case in which dominance is complete or nearly complete.

In my extensive studies of shepherd's purse (*Bursa bursa-pastoris*), I have found the usual prevalence of complete dominance, but in 1917 a peculiar form which has been designated *tenuiloba*, originated as a segregate in the F_2 of a cross between two wild strains of shepherd's-purse, derived, respectively, from Korea and from Landau, Germany, which has bred true when selfed, and which gives 1 : 2 : 1 ratios of *tenuiloba, heteris* and *rhomboidea* when crossed with a pure *rhomboidea*. The *tenuiloba* and *rhomboidea* segregates breed true and the *heteris* splits again as in the F_2. The *tenuiloba* form has the median lobes of the climax leaves of the rosettes reduced to slender bristles which diverge at a small angle from the rachis of the leaf, while the *heteris* in these families has the slender primary lobes diverging nearly at right angles to the rachis and each associated with a conspicuous secondary lobe. *Rhomboidea* has less conspicuous secondary lobing on an unelongated primary lobe.

As the three forms are very distinct, no difficulty is experienced in their accurate separation. This fact, together with the ease with which Bursa cultures are successfully handled, and the fact that the definitive stage in these forms occurs in the rosettes, thus making it possible to classify the segregates within a few weeks after the plants are transplanted from the seed-pan into three-inch pots, makes it entirely feasible to use this material in laboratory courses limited to a single semester.

To teachers who wish to diversify their laboratory work in genetics by the introduction of these forms, I am prepared to supply packets of selfed seeds of heterozygotes in such numbers as are likely to be called for. A smaller number of parcels of selfed seeds of the homozygous types is also available for those who wish to have at hand pure-bred families of these types, but as the *tenuiloba* and *rhomboidea* forms in the segregating families are pure homozygotes, it will not be *necessary* to have pure families in order to provide for the assured presence of homozygous material of the grandparental types.

No compensation is asked for this material except that the results of segregation found by students in each of the segregating families should be reported back to me, in order to contribute to a determination as to whether the slight deviations from the 1:2:1 ratio fall within limits which indicate that such deviations may be appropriately attributed to errors of random sampling.

Because of the presence of wild Bursa seeds in all ordinary soils, it is necessary in the handling of Bursa cultures to sow the seeds in sterilized soil. I make it a rule to grow 125 plants of each family in which a monohybrid ratio is expected. Greenhouse space of about one square meter must be provided, therefore, for each culture grown. The continuation of cultures for the use of subsequent classes will be very easily provided for by growing to maturity the requisite number of *heteris* plants (heterozygotes)

and placing a paper bag of suitable size over the inflorescence of each when ready to begin flowering, as the plants self-fertilize perfectly when thus treated.

In order to share in this distribution of material, applications should be made promptly, stating the number of parcels which the applicant is prepared to grow.

GEO. H. SHULL

PRINCETON, NEW JERSEY

THE PRESENT STATUS OF THE METRIC SYSTEM

IN SCIENCE, September 5, 1924, Professor Satterly, of the University of Toronto, takes exception to any plea for extended use of the metric system. His concluding argument is: "The trouble with men like Mr. McAdie is that because they like a thing they think all the world must agree with them." The professor doubtless means that some men when they have a good thing like to share it; and for the implied compliment we return thanks, although not sure we deserve such unstinted praise—and in public, too.

"I have been teaching physics in Toronto for the last twelve years and have introduced (*sic*) the English units more and more," says Professor Satterly. If his students are submissive, certainly others should not object. May the progress continue until the table of linear measurement beginning "three barley corns make an inch" is reached. Clean, dry, medium-sized corns, laid end to end. Later it can be determined how many corns make a yard, a rod, a rood, a perch, a pole or a chain.

The professor also prefers pounds, shillings and pence to the decimal money in use in Canada. He asks, "And how is it that the quarter is so popular?" The profound truth is—it is easier to get than a dollar; but if given a choice between accepting a quarter or a dollar, I know which one I'll take; and I fancy Professor John will do the same.

ALEXANDER MCADIE

BLUE HILL OBSERVATORY

HAVING been an interested reader of the various recent comments regarding the present status of the metric system as printed in SCIENCE, one or two additional observations may aid in clarifying the situation.

In the first place, why does not such a highly organized scientific group as that of the United States Weather Bureau discard the Fahrenheit thermometer with its freezing point 32 degrees above a zero which has no scientific meaning at the present time? A step in the right direction was shown in the weather map of the northern hemisphere prepared by the Weather Bureau during the early months of 1914 and suddenly discontinued on August 2 of that year when the warring nations of Europe stopped sending in the necessary data. Why not resume the publication of these maps and then adopt the same temperature scale or the common Celsius scale for the United States maps also?

Professor McAdie's arguments in SCIENCE for June 13 will be accepted without dispute by scientific workers. However, it should be borne in mind that the "cooks" and "carpenters" use the system taught them in the public schools and that very little attention is given to the metric system in the arithmetic classes of the common schools. This is due partly to the fact that a very large percentage of the teachers are not sufficiently familiar with that system to teach it effectively and in a larger degree it is neglected because neither teachers nor school supervisors have ever been convinced of its practicability and adaptability to everyday affairs. The metric system will never be generally adopted until the masses of the people are convinced of its practical value. The masses can most easily be reached through the rising generation in the common schools. The teachers can most easily be "sold" to the system if we can convince them that its use would save about a year's time in compound numbers in arithmetic. Men like Professor McAdie, who know the working advantages of the metric measures from constant daily use, have a real responsibility in bringing the matter to the attention of grade teachers, taking advantage of every opportunity that presents itself in normal schools, teachers' institutes and teachers' associations.

J. C. JENSEN

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UNIVERSITY PLACE, NEBRASKA

GERMAN BIOLOGICAL PUBLICATIONS

THE claim is made that the price of German biological publications is no higher than many American and not so high as the English. May I ask SCIENCE to publish data that show the average cost per page of this library's most recent subscriptions to serial publications issued in four countries?

Country	Average Cost per page	No. Journals in estimate
America, U. S.	$.010	27
England	.0111 +	17
France	.006	8
Germany	.016 +	29

PRISCILLA B. MONTGOMERY

LIBRARY OF THE MARINE BIOLOGICAL LABORATORY,
WOOD'S HOLE, MASS.

THE PAN-PACIFIC RESEARCH INSTITUTE

A STATEMENT in SCIENCE for August 29, page 195, quoted from the press, to the effect that I "have tentatively accepted the directorship of the Pan-Pacific

Research Institute" at Honolulu, needs a word of correction. In case the hopeful project develops as expected, I may become for a time honorary president. In this case my chief duty would be to assist in finding a suitable young man as director. This may involve visits to Honolulu, but not continuous residence.

DAVID STARR JORDAN

SCIENTIFIC BOOKS

ANIMALS OF THE YOSEMITE

ONE of the most complete of local faunas, a monumental model of accuracy, fullness, clear expression and typographical excellence, has been lately issued by the University of California under the title of "Animal life in the Yosemite." The authors are Dr. Joseph Grinnell, curator of the Museum of Vertebrate Zoology, and his associate, Tracy Irwin Storer. This contains all that is known of the life history and habits of the 331 species of animals found in the Yosemite. This list includes 95 mammals, 54 of them being rodents, 231 birds, 22 reptiles and 13 amphibians. Each is accompanied by a compact description of "field characters," color, measurements and traits not demanding dissection, and a full record of all traits of behavior, distribution and relative abundance, together with excellent photographs and paintings. Nothing as satisfactory of its kind has ever been accomplished before. The authors observe that "every precaution has been taken to insure accuracy of fact and correctness of inference. No sacrifice of precision has been made consciously with the end merely to afford attractive reading. . . . Ideally we have tried to present our science, perfectly good science, in attractive form."

A single example may serve to show the method. The Tahoe Chipmunk (*Eutamias speciosus frater*) is one of seven species of these dainty little squirrels found in the Yosemite district. Seven pages are devoted to its behavior and distribution. From this I quote a single paragraph:

> The fact that the Tahoe Chipmunk is the only one of seven local species which habitually climbs high in the trees is a point of evidence that restriction to a particular type of habitat or mode of behavior does not always rest upon the possession of conspicuous special structural features of an adaptive nature. So far as can be seen by an examination of specimens in hand, none of the other species of chipmunks is physically incapacitated for tree climbing; in fact, individuals of these others are occasionally observed well up in the trees. There doubtless *are* minor features of structure, associated with a different psychology, which account for the differing traits indicated. Age-long segregation, in separate areas of differentiation, of the several stocks may be the basis of this divergence of habitat preference. The shifting of climatic barriers, with the resulting migrations of populations, has thrown the species together as very near neighbors or as actual companions. Fatal competition is prevented as a result of these initial predilections, whereby *frater* favors the trees, *alpinus* the rocks, and *senex* and *quadrimaculatus* the brush patches and logs.

The introduction closes with a fine plea for the study of living organisms, not as a substitute for anatomy, cytology, genetics and the like, but as a worthy end in itself and as the natural beginning for the development of naturalists. In the present "dry rot of academic biology," it is well to realize that animals and plants exist in nature and through knowing them students find their most attractive introduction to the study of biology.

Dr. Grinnell remarks:

> The study of natural history should develop the power of insight, keenness, not only in seeing what animals do, but in determining why these things are done.
>
> The interrelations between any animal and its environment are exceedingly manifold and vital. To understand these brings into play a superior type of intellectual activity, and, we believe, leads to enhanced powers of perceiving and solving human problems.

The authors may be sincerely congratulated on a noble piece of constructive work, and the university they represent on the far-sighted generosity which has permitted its completion, the Museum of Zoology itself being built up chiefly on the appreciative gifts of Miss Annie Alexander.

DAVID STARR JORDAN

STANFORD UNIVERSITY

SPECIAL ARTICLES

A TENTATIVE INTERPRETATION OF THE RADIOMETRIC DATA ON VENUS

IN a recent communication in this journal were given the results of new radiometric measurements on Mars and Venus. For the sake of brevity no interpretation was then given to these data. It now seems desirable to add a few comments on our results, which, as previously stated, show that the unilluminated surface of Venus emits a relatively intense infra red radiation, that the southern hemisphere is hotter than the northern, and that the radiation emitted is highly selective. How are we to account for this condition? Water vapor is supposed to be absent; and if it were present it probably could not strongly emit radiation of wave lengths 8–15μ. Of the gases present only CO_2 and ozone could emit strongly in the region of 10.5μ. The rest must emanate from the solid surface of the planet.

If the rotation period is long then it seems necessary to assume that the surface of Venus is still highly heated and emits its own proper radiation.

If the rotation period is short then, owing to the relatively dense atmosphere, the heat would be retained for some hours after sunset, as obtains on this earth, which is less highly heated owing to its greater distance from the sun.

The fact that the southern hemisphere (the bright cusp as well as the adjoining dark region) is hotter than the northern (cusp and contiguous dark area) might be owing to a difference in surface conditions as observed on Mars. This difference in temperature may be owing to a tilting of the axis of rotation, a variation in insolation, and a consequent change in the seasons, as observed on the earth and on Mars. If this is the case then, in the course of time, temperature conditions should be reversed and the northern hemisphere should become the hotter. This, as well as several other questions, can not be answered without further observations extending over a long period.

W. W. COBLENTZ
C. O. LAMPLAND

A NOTE ON THE RING METHOD OF MEASURING SURFACE TENSION

WHEN one consults tables of physical constants for the values of the surface tension of water in contact with air at a given temperature, one is struck by the variety of values given, depending upon the method used. The ring method has been criticized because the values given (Weinberg, duNoüy) although consistent among themselves, differ considerably from the values obtained by other methods. The average of values by the ring method at 15° is 76.6 dynes per centimeter, whereas a probable average of values by other methods at the same temperature is 73.4 dynes per centimeter. The difference of 3.2 dynes remains to be explained.

Fahrenwald[1] attempts an explanation of the high values obtained by the ring and similar methods, in stating that in addition to the true surface tension there is a force due to a column of liquid beneath the edge (ring) to which the liquid adheres; and that this column is supported, not by the surface tension, but by attraction between the edge (ring) and the liquid molecules. Although the explanation is correct for the equilibrium condition when the upward pull on the ring is much below that attained at the instant of rupture, it does not apply in the latter instance.

In our analysis of methods used in measuring surface tension we may logically assume that in any simple liquid, such as water, surface tension is a definite physical property which, under fixed conditions, should be quantitatively expressible with a degree of accuracy limited only by the experimental conditions. The outstanding difference of 3.2 dynes is a strong indication that a source of constant error, either in the ring method or in the other methods, must have been overlooked by the experimenters. Recently, in making measurements with the apparatus of duNoüy, the writer had occasion to determine if possible whether the difference might be attributable to the ring method or merely to the technique by which the measurements are made. That Fahrenwald's explanation is probably incorrect is shown by the fact that as the ring is pulled up out of the surface by the application of increasing force, there is a point at which the liquid adhering to the ring is suddenly drawn out into a thin annular film, several millimeters long, yet retaining stability. As the force is gradually increased the point is finally reached at which the film breaks. This film is so thin at the instant of rupture that an error of 3 dynes certainly can not be attributed to it. It is found further that after the ring has been pulled away, droplets adhere to it. DuNoüy has found (private communication) that the weight of these droplets for a given size of wire in the ring is very constant indeed, their weight amounting to about .24 dyne per centimeter length of wire for the size used in the duNoüy tensiometer. This value increases with increasing thickness of wire. Obviously the amount of liquid pulled away with the ring does not account for the difference of three dynes.

The following explanation is believed to be the correct one. As the ring is drawn out of the liquid the upward force on the ring, measured by the torsion of the wire, is just balanced by the weight of liquid elevated above the normal surface. It is important to note that the scale readings of the instrument are taken with reference to the scale zero, and that the scale zero corresponds with the actual zero of torsion only when the arm which carries the ring is in its position of zero-balance. As the ring is pulled higher with increasing force, the true zero on the scale, with reference to which readings should be taken, shifts upward from the scale zero by an amount which corresponds to the position of the arm. Consequently, at the instant the film ruptures, the scale reading will be too high.

A new technique has been devised whereby the vessel containing the liquid is gradually lowered, by means of the screw adjustment on the support, while the increasing force is being applied, all the while maintaining the arm in its position of zero-balance. Thus the scale zero remains the true zero, and therefore readings of the scale will correctly represent the force at the instant of rupture. The error due to the droplets adhering to the ring is easily corrected by

[1] J. O. S. A. and R. S. I., 6, 722, 1922.

considering them as part of the ring and adjusting the zero balance of the instrument with the droplets adhering to the ring.

Experiments to test this explanation have shown a difference of 3.3 dynes per centimeter for water when the former technique and the new technique, respectively, were employed. This brings the results by the ring method into agreement within .1 dyne with the average of the values obtained by the other methods. The modified technique therefore bridges the gap between the ring method and the group of other methods cited in the literature, and it finally removes whatever doubt there might have been about the trustworthiness of the ring method.

A more detailed description of the new technique, together with experimental data, will be published elsewhere.

Paul E. Klopsteg

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Central Scientific Company,
February 15, 1924

HEAT OF WETTING AS A NEW MEANS OF ESTIMATING THE COLLOIDAL MATERIAL IN SOILS

One of the greatest needs in soil studies is a method for determining the amount of colloidal material in soils, for it now appears that most of the chemical and physical reactivities and properties of soils are due mainly to their colloids. Such phenomena as adsorption and absorption of chemical reagents, moisture adsorption and retentiveness, heat of wetting, unfree water, rate of evaporation of water, plasticity, cohesiveness, etc., are all closely associated with or mainly controlled by the colloids in the soil. To intelligently understand and compare the different soils with one another it is important and essential, therefore, to know their colloidal content.

At present there is really no method for determining quantitatively and accurately the colloidal material of soils. There have been several methods proposed, but it appears that all of them involve serious errors. Probably the most important methods proposed are those based upon the adsorption of dyes and those upon the adsorption of liquid vapors. The methods in the first category involve the serious error that the different soils contain different kinds of colloids which adsorb the same dye differently and consequently the results are reliable neither quantitatively nor relatively. The methods in the second category contain several disadvantages which may be accompanied with serious errors. Some of these disadvantages are as follows: (1) Besides the real surface adsorption there may also be a capillary absorption, *i.e.*, a condensation of vapor in the capillaries; (2) there may be a condensation of vapor by a slight change of temperature; (3) the procedure is long and uncertain as to when equilibrium is attained.

The present writer has been interested in trying to work out a method for determining the colloidal material in soils for some little time. After trying out several methods, including those mentioned above, he has come to the conclusion that the heat of wettings presents probably the best means for estimating the colloidal content of soils, as well as their state of activation. It has been found that the heat of wetting of soils is due mainly, if not entirely, to their colloids, as non-colloidal material even in very fine state of division does not produce heat of wetting. For instance, rocks and minerals ground to very fine condition fail to give any measurable amount of heat of wetting. Even colloidal soils which give a tremendous amount of heat of wetting in their natural state fail to give any heat of wetting after being ignited, even though they may be ground extremely fine.

It has been found according to this method that the colloidal content of soils may range from 0 to as high as 80 per cent. of their weight and that the average soils contain a far larger amount of colloids than is commonly believed.

One of the interesting things that this method has revealed is the fact that the reactivity of material may not depend entirely upon the size of its particles but also upon the state of its activation. The latter may be due to several factors such as degree of decomposition, nature, etc. It would seem that the reactivity of the material may be more important than the size of its particles.

The procedure of the method consists of determining the heat of wetting of the soil, then extracting a certain amount of colloids from the soil and determining their heat of wetting. Knowing the heat of wetting of both the soil and the extracted colloids, the colloidal content can be readily calculated. It may be possible to ascertain the colloidal content of a soil by multiplying its heat of wetting with a factor, without having to extract the colloids.

The method of determining the heat of wetting is very simple, rapid and accurate and appears to be far superior to the vapor adsorption and dye adsorption methods.

Several other liquids besides water have been employed to determine the heat of wetting, but it was found that these other liquids did not react with all the different kinds of colloids in the soil, but water reacted with all of them.

A detailed report of the investigation is now in preparation.

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SCIENCE

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CONTENTS

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RECOGNITION OF THE INDIVIDUAL[1]

I DEEPLY appreciate this opportunity for laying before this association certain facts and theories of applied psychology which may have a bearing on the organization of engineering education.

The discovery of the individual and the study of his traits and needs in modern psychology has brought forth a maxim in which I wish to couch my proposition for engineering to-day: "Keep each student busy at his highest natural level of achievement in order that he may be successful, happy and good." This maxim is so pithy and cogent that we can afford to read it and reread it, accenting in turn each individual word, as each word of it stands for a principle and each word charges us with a responsibility. Thus, we may emphasize in reading, each, his, highest, natural, achievement, successful, happy and good.

An attempt to carry out that program will make it necessary to take into account: (1) The selection of the individual; (2) the placement of the individual at entrance; (3) the organization of individual groups; (4) the guidance of the individual; (5) the motivation of the individual; (6) the reward of the individual.

Mass production in education and recognition of the individual are two of the foremost problems in education to-day. They loom up large in contrast, because they seem to involve mutually contradictory problems. It is generally believed that mass methods stamp out the individual or, conversely, that recognition of the individual prevents the use of mass methods. But mass education is forced upon us, and the recognition of the individual with his personal traits, limitations, capacities and aspirations is coming to be a persistent demand.

Facing this situation, I am optimistic, believing that a *large* professional school is a good thing and that it is possible to so radically change from the traditional small college methods of instruction to the methods demanded for mass education that we shall be able to deal with students in very large numbers more effectively, more personally and with more precise recognition of the individual than was ordinarily achieved in the small professional school.

The new day in society and the new day in education is marked by the fact that instead of a mere hit-and-miss growth we are assuming conscious control of the evolution of educational tendencies, of the de-

[1] Address before the Society for the Promotion of Engineering Education, at its meeting in Columbus, Ohio, July, 1924.

velopment of the individual and of the shaping of the needs of society.

I. The Preliminary Selection of the Student: A College Qualifying Examination

The great tragedy of all higher education to-day is the maladjustment, failure and misdirection of the student entering college on the towering and surging wave of "education for democracy." From 5 to 50 per cent. of freshmen fail and are eliminated in the first year. These students are sent back to home and community disgraced and disheartened, and constitute not only an economic waste, but a gross maladjustment of human energies, hopes and ambitions.

For this there is a simple remedy, and that is to develop a nationally standardized college qualifying examination which shall be given at the end of the senior year in all high schools and preparatory schools as a basis of information with reference to fitness for college work. On the basis of this examination parent, pupil and teacher may make a rational estimate about the wisdom of going to college; and this examination, which is given merely for information, will be accompanied by expert analysis and advice in general principles of vocational guidance with reference to the outlook for persons of the various degrees of fitness for higher education.

Such an examination is being developed under a five-year experiment now in progress. Two thousand high school students are examined annually. Prediction of probable success is made and this is correlated with the actual achievement of those who go to college, wherever they go. Thus we shall have a quantitative measure of the degree of precision of our power of prediction. The preliminary findings are exceedingly gratifying in this respect.

This examination will also serve to educate the community to the slogan, "It makes a difference"; it makes a difference whether a student is or is not capable of doing college work. It will serve to encourage and select those who may not be fully aware of their high qualifications, and to discourage and eliminate those who are not fitted, not only on the basis of this examination, but on commonsense observation in daily life, when the principle is once recognized and becomes a part of the neighborhood commonsense. The student will make his decision about going to college on the basis of an inventory of his fitness for college, before he has burned the bridges behind him by actually going to the college or even announced to his friends that he was or was not going.

Now at this stage we can not distinguish between the engineering and other professional or liberal arts students. It is enough to know that that student who is fitted to go to college is encouraged to do so, and that one who is not fit is discouraged on the basis of specific information about fitness for higher education.

II. Placing the Individual: Department Placement Examinations

When the student enters the engineering school, he should be required to take a placement examination in each of the first-year subjects, such as English, chemistry, mathematics. This examination, administered by each of the departments independently, is designed to show: First, the degree of natural aptitude for the particular subject; and, second, the character of preparation in that subject. It will be so prepared as to furnish the most effective introduction to the subject in the form of practical exercises for the first two or three days of the course. It will be of the objective type and can be administered and scored easily, quickly and uniformly by cheap help so that, at the end of these exercises, the instructor will have in hand a rating for semester placement which shall be of as high predictive value as the experience of the entire first term in a heterogeneous group, provided the student is willing to work. The student will have had a most effective introduction to the subject. These examinations will be prepared in small pamphlets and bought by the students like text-books at about ten or fifteen cents apiece. It is desirable that national standards should gradually be developed and furnished in fresh editions annually from the hand of the most expert writer in each of the respective fields.

The use of such placement examinations is absolutely essential if we shall start our student rightly at his natural level for achievement, taking into account natural aptitude and character of preparation in the subject as a basis for determining the pace at which he shall be set to work and the character of his task. The present practice of squeezing into the same form those who are by nature and by training radically different in their equipment and ability for doing the work of a given subject is indefensible.

III. The Natural Grouping of Individuals: Sectioning of Classes

The most wholesome tendency in modern higher education is in the direction of individual instruction or, I should say, the privilege of individual work. In its organized form this takes the character of socialized group instruction, in which there is a natural give-and-take in the struggle for achievement, as in ordinary life, and the student is encouraged to pursue knowledge *actively* instead of having it poured into him as by our present methods. For this we are, however, not quite ready, except in the laboratory subjects, as it calls for a radical reconstruction of our curriculum. As a temporary measure, our

best procedure is to section classes on the basis of ability. After a careful study of all three methods in actual operation, I am convinced that any one of these three methods can be adopted effectively in fundamental courses without increasing the cost of education, and without the much dreaded conflicts between courses, while vastly improving the efficiency and naturalness of the educational process.

Sectioning on the basis of ability was in vogue in the best colleges of the country two generations ago, but was gradually dropped when elective courses were introduced, on the theory that it created conflicts. This theory of conflicts was exploded a few years ago by the discovery that if students, in a given course in which there are two or more instructors, are registered by the hour instead of by the number of the section in parallel sections, interchange of students at a given hour can be made at any time during the semester by the two or more instructors in that hour, without the slightest interference with other departments or other courses in the same department. To illustrate, let us suppose that there is a class of one hundred students in freshman mathematics, and that fifty of them may schedule at 8:00 o'clock and the remaining fifty at 11:00. Then the two instructors in each of these hours may agree that one shall have the better half and the other the poorer half of the class reciting at that hour, and that promotion and demotion between the two sections may be made, and shall be made, on the basis of achievement at any time during the semester. Such sectioning establishes a fair basis for praise and blame, introduces fair standards of achievement and creates a morale in the class. To the poor student it means kindness, comfort, justice and opportunity for relative efficiency and approbation. To the gifted student it is a means of finding himself and being motivated by effective competition, freedom from a dead load, stimulation of initiative and the joy of achievement. This method is now the approved method in the best elementary and secondary schools of the country, and all fundamental college courses are fast coming to that practice.

The method of sectioning combines well with lectures and demonstrations in large divisions, as the students at a given hour may meet in a large division for lectures. In laboratory work, it is however unnecessary, because here we can readily employ the method of the socialized group, allowing each student to work and progress at his natural level of successful achievement, the essential requirements being that about three times the ordinary amount of work shall be mapped out, and that the good students shall be so motivated as to distinguish themselves, both in quantity and quality of work, that the highest 25 or 30 per cent. of the grades shall be given for work clearly above that represented by the highest grade ordinarily given in the unsectioned group.

Sectioning on the basis of ability or individual freedom in the laboratory is, however, of no avail unless instructors adapt their methods and requirements to the radically different abilities now segregated. The procedure in each group, examinations, standards of achievement, sequence of courses for students at different levels, must all be adapted to the new situation. For each of the levels a different quantity of work is mapped out and a different quality of response must be required. At the lowest level there must be patient pedagogical drill on the fundamentals. At the highest level, the atmosphere of the scholar with its freedom, large scope and enthusiasms will prevail.

IV. The Guidance of the Individual: Natural Finishing Places

The societies here represented are primarily concerned with the standard engineering course which has a professional status, but in evaluating the setting of such a course, we must view it in relation to this fact, that the extension of the type of training represented by engineering should be varied in proportion to, first, the needs of society, and, second, the capacity of students for training.

If this is true, other natural finishing levels than that set for the professional course should be provided, some longer and some shorter. Corresponding to the various departments of engineering, there should be junior engineering courses (not necessarily by that name), preferably of two years of a combined trade and cultural character leading to a certificate which would motivate our skilled tradesmen who are reasonably educated for democracy. The automobile mechanic, the head carpenter, the plumber, the road builder and the hundreds of others who now face the alternative of four years or nothing, or a part of four years and disgrace, should in this school find the greatest opportunity that has ever yet been offered for the training of intelligent leadership among tradesmen.

I know there is a skeleton in the closet, but the situation must have an airing, for if we are going to extend higher education for democracy, it can not be done by merely increasing the standard professional group. We must provide other outlets which shall enjoy the favor of occupational sanction. This is different from the ordinary trade school or manual training high school. It is trade education as a part of higher education. I would have these students take the so-called classical high school course and acquire scientific foundations for trade skill at the college level.

While such a trade school will probably be independent of the engineering school, the latter must

function sympathetically in launching and sponsoring the former, and in the development of a good concept of education for skill in applied sciences beyond the high school level, particularly in promoting its certification.

Beyond the first degree in engineering, I would have various stages of specialized training in proportion to the needs for highly specialized experts and their capacity for training, even as far as five years of graduate work.

Now I submit that the lower the finishing place, the more men of that training we need, and the more qualify reasonably for it. In rough figures, we may say that for each engineer who takes five years' post-graduate training, five should take three years and twenty-five should take one year. For every professional engineer of the standard course, we should have from two to five times that many educated tradesfolk with a two-year certificate; for society needs a great many more men of the lower training than it does of the higher, and nature has provided a great many more for educability at the lower level than at the higher.

We as educators can not visualize this profile of distribution without feeling great responsibility for an inventory of our concepts of natural units for education in applied science. We can not guide the mass of youth who clamor for engineering education in the future without taking active steps to assist in the sorting or the progressive selection and elimination for different levels of training in applied sciences.

The recognition of this concept in the organization of training in applied science will have great value for the professional engineering course, in that it will furnish a means for progressive selection *for* and elimination *from* that course, thus securing a better grade of professional students and a motivation for those who are to do graduate work in engineering specialties.

V. MOTIVATING THE INDIVIDUAL: SPREAD OF ASSIGNMENT

The procedures for motivating the individual are countless and should be varied. They may vary with the character of the subject, the character of the instructor, the character of the institution; and it must always be kept in mind that different *levels* of capacity must be appealed to by entirely different principles of motivation. Let me but mention one: the setting out of a task in which there shall be room for spread in achievement in proportion to the spread of capacity in achievement. To take a concrete example, entirely arbitrary: if the standard for achievement in freshman chemistry for the first year is represented by one hundred exercises of a certain degree of difficulty from the old point of view, this must be abandoned and work covering from two to three times that amount must be set out as a possible and desirable goal for achievement, with the expectation that a very small percentage of the class may achieve that goal and that there will be a gradual distribution from this maximum achievement down to the point of failure. If it is announced that this three hundred unit basis represents the scope of the course and that grades will be awarded on the basis of achievement on *this* scale, taking into account the quantity and quality of work, then it will be found that more than 25 per cent. of the class when properly motivated will be distributed between the one hundred and the three hundred units of achievement: that is, above the level of the task ordinarily set for the class.

That this extraordinary enhancement of achievement actually does take place is illustrated in classes in which it has been tried by the fact that (again using figures roughly) where a modern type of examination is given to all levels of the class, and is so arranged that the poorest students can only answer the first few questions, and that the best students will have the real test of their abilities in answering the last and most difficult questions, it will be found necessary to change the passing mark, say, from 70 per cent. to some empirical figure like 25 per cent., assuming that we know and wish to maintain the old standard of fitness for passing. That is, what under the old conditions used to represent 70 per cent., or a passing mark, represents only 25 per cent. on the new scale. This is not lowering the standard of passing, but is raising the standard for achievement and basis for recognition of achievement on the part of the best students.

In my own classes in psychology, for example, all A's and B's (*i.e.*, about 25 per cent.) are given to students whose achievement is clearly beyond the standard of achievement which was expected before the principle of segregation was introduced.

This first principle of motivation, then, of setting out a larger program, furnishing the material for the performance, making it known that grades will be based upon achievement, and that achievement will be measured at the level at which the work has been done, is a principle which can and should be applied in all subjects. In setting out such a program, it should be clearly understood among the students that each will be kept busy at his highest natural level of successful achievement; that there are very great differences in the capacity for achievement; that each will be praised or blamed according as he achieves on the basis of his natural capacity, and that we have frankly given up the idea of bringing them all to the same level. It is important that no student shall be permitted to feel that he is doing extra work when he is actually working at a high level of achievement.

The laboratory, of course, lends itself very freely to this type of procedure, and while there are various methods of laying out the program, it will probably be found in general that the best way is to arrange for each level a series of exercises or tasks, increasing in the order of difficulty so that the whole class is kept together on topics from day to day, and that the spread of achievement will be represented by quantity and quality of work on each topic. This is opposed to the idea, often prevalent, of setting out a mediocre standard and allowing the good students to pass rapidly from topic to topic, thus gaining time. There is no topic in any subject that does not lend itself to various degrees of intensive and effective work, and it is a better test of a good student that he shall have done a higher amount and a better quality of work on every topic than that he shall have passed rapidly over a minimum requirement.

VI. The Reward of the Individual

The greatest reward for a good student is the joy of achievement. If we once liberate the good student, give him facilities and encouragement to work at his natural level of successful achievement, formal and outward marks of distinction will be of little consequence as compared with the deep satisfaction in doing this kind of work. To make this enjoyable, many institutions must, however, change their atmosphere so that both students and faculties will hail the superior student with approbation, instead of looking upon him as a "grade-getter" or a union scale breaker.

Nevertheless, the good student should be entitled to certain rewards. Aside from the privilege of being relieved from learning things that he already knows, doing things that he already knows how to do and marking time for the sake of the order of the class, certain natural rewards would be in place. Under the plan I have advocated, high grades will assume an entirely new meaning, and will in themselves constitute a much desired goal, a reward of honor which requires no special action of the faculty, because high grades under the conditions described will imply that the student has traveled in high sections, covered a much more extensive field and done a far better quality of work than is now ordinarily required.

If honors are to be awarded by the faculty in a professional school, I think that they should be awarded on the basis of ranking of a number of students who have good grades, taking into account, first, the grade; second, the special marks of achievement deserving of recognition, particularly a scholarly attitude; third, balance of activities, representing health, socialization and academic life, and fourth, personality, in the sense in which personality is judged when an engineer is to be employed.

Taking this broader basis into account would protect the institution from making the egregious mistakes that are often made when honors are awarded on the basis of mere school record.

In the above, I have proceeded upon the assumption that students shall be held together during the customary period of four or five years in the regular order of topics and shall all take the same time. This, I think, would be entirely justified when, in the new order of things, the good student can have during these years the most excellent opportunities for natural growth and self-expression.

There is, however, another possibility which I should advocate if we can not recognize motivation on the basis of ability, and that would be to adopt the method of individual instruction, which would enable the student to finish his course in a time somewhat proportionate to his capacity for work. There are many points in favor of this method, aside from the mere justice of it, and many of the difficulties which have seemed to stand in the way are mere bogies. However, if I had my choice, I should take the stand in favor of keeping the student in the engineering course to cover specific subjects in a specific time, and then differentiate the quantity and quality of the work to be done in each topic.

I have spoken as an outsider, as boldly as briefly, on some of the most vital subjects touching engineering education, and have deliberately tried to set forth the ideas in high lights and concrete form, in order that they may be tangible as a basis for discussion. Some of the things I advocate are already coming into general practice. All have been tried in some form. I have sought to find fault with existing conditions in a constructive spirit, and am glad to recognize that engineering draws as high a grade of students as any other profession and is probably better taught. I bring no revolutionary theory or simple solution, but it seems to me that the items I have mentioned are among the next vantage grounds that we might survey in engineering education.

C. E. Seashore
State University of Iowa

SHADED TOPOGRAPHIC MAPS

The latest advance in the art of mapmaking at Washington is seen in certain inch-to-a-mile governmental maps on which the relief, still shown by contour lines as heretofore, is rendered more apparent by the addition of shading. The device is not new: it has been employed, for example, on the 1:100,000 map sheets of Italy published some years ago by the Military Geographical Institute at Florence, and on certain maps of the Rocky Mountain region published by the Geological Survey of Can-

ada; but shading is a rarity on American official maps, and in few if any others yet issued is the shading so delicately treated as on those here to be described.

The maps under consideration are at present in process of more or less experimental production by the Geological Survey under the Interior Department, and by the Corps of Engineers under the War Department, each organization working for its own objects and by its own methods in friendly competition; indeed, some of the engineer officers concerned with the making of the maps had their topographic training as members of the Geological Survey. A first trial was made by both organizations two years ago on the contour map of the Monument Springs quadrangle, Texas; more recent trials, which appear to be in several respects more successful than the first one, are on maps of different quadrangles.

The maps prepared by the Geological Survey are expressively shaded by hand on photographically enlarged prints, as if under a northwestern illumination, the shading being darker where the contours are close together, and lighter where they are open spaced. The shaded map is then reproduced on reduced scale by successive photographic and lithographic processes and printed on the original contour map. It is found desirable that a contour map should be recently printed before the shading is overprinted upon it, in order to avoid inaccuracies of registration that might result from the use of contour maps a year or more old, the paper of which may have shrunk appreciably.

The maps prepared by the Corps of Engineers[1] are reproduced photographically from obliquely illuminated models, the making of each model requiring several processes: first, cutting out successive sheets of cardboard along the contours of a somewhat enlarged original map, the cardboard outside of the contours being used to build up an inverted relief or mold; second, a positive, cast from the mold and reproducing the successive "steps" of the cardboard sheets, is graded with beeswax and tooled to a smooth finish; third, a new mold is made from this positive; fourth, a final positive or model is made from the new mold: it is this model that is then photographed down, under oblique illumination, to the desired scale, and the shades thus secured are printed on the original contour map.

On examining the maps thus produced, it is immediately manifest that they make the relief of the land surface wonderfully clear; indeed, at a little distance it is difficult to believe that the maps are printed on flat paper, so vivid is their model-like appearance. If such maps came into general use, their educational effect on adults as well as on junior students will be geographically most beneficial; for while the appreciative reading of contour maps requires special training, the reading of a shaded map requires only such training as the eye naturally acquires in its everyday experience of illuminated objects. Shaded maps, therefore, teach the facts concerning land forms in an emphatic way that contour maps do not. It will be interesting to learn what response is excited by these excellent maps among the public of the several areas that they represent, as well as in the schools and colleges in other parts of the country where maps are used in teaching.

In the meantime a comparison of the maps thus far issued brings forth some interesting contrasts. The most striking at present is merely a matter of colors employed. The sheets lately published by the Geological Survey for certain quadrangles in Pennsylvania and West Virginia are given an appearance of much delicacy by the use of light tints: the contours are printed in a lighter brown than that used on ordinary maps; the cultural features, including names, are printed in a dark gray instead of in full black as usual; and the shading of the relief is very gently modulated, so gently, indeed, as to give the impression that the map is veiled. A somewhat darker shading might be better.

The engineers' maps for certain quadrangles in California and Washington are more vigorous in appearance: the contours are in strong brown, culture in full black, and the shading is fairly dark: hence the whole effect is bolder than that of the survey sheets, and may give the impression of stronger relief than that possessed by the areas represented. Here a somewhat lighter shading might be recommended. In both sets of maps the presence of contour lines on the illuminated slopes lessens their illumination and thus tends to weaken the impression that is intended to be given; here the pale brown contours of the survey maps are less obvious than the darker brown of the engineers' maps.

The above differences are not inherent. They can be lessened, if desired, by the use of different inks. If the maps are to come into general use, the same color-scheme of shading is evidently desirable for both sets. A more fundamental difference is found in the distribution of the shading. On the survey sheets, the down-slope of a hill or ridge away from the assumed source of illumination is shaded from crest to basal stream line, lighter for gentler slopes, darker for stronger slopes. The other side of the ridge sloping toward the source of light is left unshaded.

[1] An account of the development of these maps has been prepared by Major Albert M. Walker, under the title, "The military map of the future," and published in the *Military Engineer* for September–October, 1923.

But on the engineers' maps, the shade on the non-illuminated down-slope of a ridge is not infrequently continued beyond the basal stream line by the shadow of the ridge on the next up-slope: hence the line of change between shade and illumination does not here always lie along the stream line of a valley bottom; indeed, a subordinate ridge on the non-illuminated slope of a higher ridge may be wholly shadowed in this way. As the contours are somewhat obscured by the dark shading here adopted, a close inspection is needed in order to determine whether the edge of the dark tint in a hilly area lies along a valley bottom or not; and to this extent the easy legibility of the maps is lessened. On the other hand, partly because of stronger shading, partly because the shadow of a lofty ridge extends out over the low land somewhat beyond the ridge base, the engineers' maps give a more immediate impression of dominant features, the recognition of which on the survey maps calls for closer attention.

As to the relative truthfulness of the two sets of maps: It is a general principle that every additional process introduced between an original manuscript map, as drawn by a skilful topographer in the field, and the final printed map, ready for distribution to the public, is likely to cause some slight loss of accuracy. Such loss is presumably minimized in photographic processes, but even there difficulties arise in connection with such matters as the variation of a sheet of paper with changes of humidity, as above alluded to. Manual processes are more difficult to control, and they here intervene in both the methods of producing shaded maps: in the hand-shading and in certain lithographic processes of the survey maps, and in the contour cutting as well as in certain later processes such as the building of the cardboard negative and the tooling of the first positive of the engineers' maps. But in both cases, errors are lessened by care; and as far as I have had opportunity of inspecting the work of making the maps, skilful care is exercised at every step of both methods.

The delicacy of the hand-shading on the survey maps is truly admirable; yet it can hardly have the authenticity of the shades as photographed from a model on the engineers' maps. Similarly, the accuracy of the jigsaw contour-cutting for the engineers' maps is remarkable; it is much increased by the use of a fine wire-like saw, with minute teeth on all sides, so that the cardboard may be fed against it in any direction; yet it would seem impossible that sharp angles such as are occasionally found in contour lines should be cut by this mechanical device. Again the tooling of the beeswax on the first cast model may fail to follow the cut contour lines here and there, especially in sharp reentrants. Yet as far as I have been able to learn, the final accuracy of the two sets of maps is closely comparable.

These new-style maps as produced by the Geological Survey have not been officially given any special designation. "Shaded maps" would seem to be a natural name for them, as they are darkened only on slopes turned away from the source of illumination. A possible confusion may be feared from the misuse of the term, shaded, for hachured maps also, but such confusion would be avoided if hachured maps were so called. The name "Shadow maps" has been proposed, but it seems unsuitable because the term, shadow, is properly used for the darkened part of a surface which is turned toward, not away from the source of illumination, but which fails to be illuminated by reason of some opaque object that stands in the way of the light. True, the engineers' maps include some shadows of precisely this kind, as has been pointed out above; but they are on the whole disadvantageous features, and as such do not serve well for a name. The engineers' maps have been officially called "Pictorial relief maps," but apart from the cumbersomeness of a trinomial term, the word "pictorial" seems unsuitable because, vivid as the maps are in the expression of relief, they are not at all pictorial in the ordinary sense of that word, which is commonly associated with perspective representation, and not with vertical projection.

The technical uses of these fine maps by the organizations which produce them are not here considered: it is their geographical value that should bring them into general notice. Fortunately, they are not secret official documents.

All the shaded maps thus far produced by the Survey and by the Engineer Corps may be purchased by the general public at ten cents each.

W. M. Davis

Harvard University

SCIENTIFIC EVENTS

FIRST CONFERENCE OF SPECIAL LIBRARIES AND INFORMATION BUREAUS

The first Conference of Special Libraries and Information Bureaus was held from September 5 to 8, at High Leigh, Hoddesdon, Herts, England. Over eighty men and women interested in various ways in the collection and dissemination of informative matter attended.

The objects of the conference were outlined at the opening session by Dr. R. S. Hutton, director of the Non-Ferrous Metals Research Association, and J. G. Pearce, director of the Cast Iron Research Association. It has long been felt that many diverse agencies concerned with the treatment of information have

problems in common, and needed an opportunity to establish mutual cooperation and assistance, and to determine their relationship to the press, and to the great municipal and national libraries and other institutions.

Subsequently, Allan Gomme, librarian to H. M. Patent Office, London, B. M. Headicar, of the London School of Economics, and Dr. S. C. Bradford, of the Science Museum, South Kensington, addressed the conference on their respective libraries.

Group meetings on the scientific, industrial and economic libraries were addressed by W. M. Corse, of the National Research Council, Miss L. Stubbs and H. G. Lyall. The session on economic and statistical libraries indicated valuable developments which are taking place with regard to forecasting of trade tendencies.

An address by Lieutenant-Colonel J. M. Mitchell, secretary to the Carnegie Trustees, outlined the policy of the trustees with regard to special libraries, and L. Stanley Jast, chief librarian in Manchester, and Lieutenant-Colonel E. L. Johnson, director of the Cleveland Technical Institution, dealt with special libraries in relation to other libraries and institutions.

Among the details of methods and equipment, Dr. J. C. Withers, of the British Cotton Industry Research Association, presented a paper on abstracting, and H. Rottenburg, of Cambridge, on a guide to scientific and technical literature. Bibliographical aids to special libraries, such as "The subject index to periodicals" and "World list of scientific periodicals" were considered.

The important function of the press in collecting and distributing information was dealt with by F. H. Masters, editor of *The Electrician,* and V. C. Faulkner, editor of *The Foundry Trades Journal,* and at the concluding session, Dr. E. A. Baker, director of the school of librarianship, University College, considered the question of training men and women for work in special libraries.

The conference, which was highly successful, provided abundant evidence of the interest in this field of work, and in order to ensure continuity of interest, without forming another association, a standing committee of the conference was appointed with power to consider matters in the interests of those engaged in directing or operating special libraries, and to convene a further conference at some future date. This committee is representative of a wide range of institutions, and has already held its first meeting.

The most striking feature of the conference was the keenness displayed by a large number of highly diversified interests, including scientific, technical, industrial, wholesale and retail commerce, railways, political, agricultural, governmental, universities, press, medical, sociological and banking. This diversity served merely to emphasize the common interest of all these agencies in receiving, treating and distributing documentary material.

A. F. RIDLEY, *Librarian*

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION, BIRMINGHAM, ENGLAND

INVESTIGATION OF REINFORCEMENT IN CONCRETE ROADS BY THE NATIONAL RESEARCH COUNCIL

THE details of plan and procedure to be followed in the investigation of the economic value of reinforcement in concrete roads, being undertaken by the Highway Research Board of the National Research Council, are now completed and field examinations are about to commence. Director Chas. M. Upham reports that the various state highway commissions will actively cooperate with the board in conducting this investigation. Except in cases of actual failure, inspections will concern principally pavements having had at least five years of service, a great number of which are located in states such as New Jersey, Ohio, New York, Pennsylvania, Delaware, Wayne County, Michigan; Milwaukee County, Wisconsin; Iowa, Illinois and California.

In this intensive study an effort will be made to determine from a survey of existing roads the influence of steel reinforcement on the resistance of the slab to traffic, subgrade and climatic conditions; the conditions under which steel reinforcement is especially beneficial to concrete slabs; the effect of slab design on the efficiency of reinforcement, and, finally, the relative cost of plain and of reinforced concrete roads, considering the initial investment, and the annual maintenance and renewal charges.

The procedure will consist of a personal examination of a sufficient number of existing road surfaces to cover different slabs, traffic and climatic conditions. It is proposed to supplement the examination by photographs, sketches, soil determinations and other available data. In each case, attention will be given to a study of the subgrade to determine its general characteristics and properties as well as the existing drainage conditions. In the case of the slab, a study will be made of original data to determine the materials and proportions that entered into the concrete, the method of construction that was followed and the particular cross section used. Careful note will be made of joints, cracks, replacement areas and general surface conditions. The influencing factors of grade, alignment, location and maintenance will be noted, and the matter of age, traffic and climatic conditions will be given careful consideration. In the case of the reinforcement, a study will be made of the rela-

tive amounts of longitudinal and transverse steel, the method of treating reinforcement before placing, as well as its position in the slab. The form of the reinforcement will receive consideration to determine the relative values of fabric, rods and other types in use. An effort will be made to determine the comparative value of hard steel and of mild steel for reinforcement, and the influence of continuous and non-continuous reinforcement. Wherever possible, the present condition of the reinforcement will be noted for breaks, rust and other features of interest. Wherever obtainable, cost data will be secured covering the original as well as the maintenance investment.

The preliminary work of assembling data now available will soon be completed, at which time the field inspections will begin. The itinerary will be made out after further study, but it is proposed to pursue the investigation in the northern sections until cold weather, when attention will be turned to the southern locations. It is expected that a progress report will be ready for the annual meeting of the Advisory Board on Highway Research to be held at the building of the National Research Council on December 4 and 5.

INSTITUTE OF RESEARCH AT LEHIGH UNIVERSITY

Announcement has been made of the establishment of the Lehigh Institute of Research by the administration of Lehigh University. In announcing the purposes of the institute, the Board of Trustees, of which E. G. Grace, president of the Bethlehem Steel Corporation, is president, stated that the object is

> to encourage and promote scientific research and scholarly achievement in every division of learning represented in the organization of the university; and in recognition of the need for further and more exact knowledge in science and in the applications of science to the affairs of modern life. It is believed that this organization will be helpful in stimulating interest in liberal and professional education; and that it will prove to be of value to the professions and industries of the nation.

The Lehigh Institute of Research will afford training in research methods to the following classes of individuals: the members of the teaching staff of the university; the members of the scientific staff of the institute, including research fellows, research assistants and research professors appointed by the university and paid by it from its own funds or from funds for the purpose supplied by an individual, a firm or a corporation; graduate students in the university; special investigators temporarily employed for work on a particular investigation. The founding of research fellowships or research professorships in the Lehigh Institute of Research is a means for encouraging research and for assisting promising men to secure advanced training in the methods of research. The first fellowship of this kind has been founded by the New Jersey Zinc Company, and is known as the New Jersey Zinc Company's Research Fellowship in Science and Technology.

To preserve the records of its investigations and to render them available to every one interested, the Lehigh Institute of Research proposes to publish and distribute from time to time bulletins presenting the results of investigations conducted by or under its direction, and to issue other material which may be helpful to the various interests which it seeks to serve. Under certain conditions, and with the approval of the executive board, reports of such investigations may be presented before professional or other learned societies and published by them.

The executive board of the Lehigh Institute of Research is composed of the following: Dr. Charles Russ Richards, president of the university; Harry Maas Ullmann, professor of chemistry; Ralph Justin Fogg, professor of civil engineering; William Esty, professor of electrical engineering; Lawrence Boylston Chapman, professor of marine engineering; Fred Viall Larkin, professor of mechanical engineering; Dr. Bradley Stoughton, professor of metallurgy; Howard Eckfeldt, professor of mining engineering; Barry MacNutt, professor of physics; Dr. Benjamin LeRoy Miller, professor of geology; Dr. Robert William Hall, professor of biology; Dr. Neil Carothers, professor of economics; Dr. Lawrence Henry Gipson, professor of history and government.

SCIENTIFIC NOTES AND NEWS

The Rensselaer Polytechnic Institute held special convocations on the occasion of the celebration of the centenary of its foundation, on October 3 and 4. On the first day the degree of doctor of engineering was conferred upon President Sir Charles Langbridge Morgan, of the Institute of Civil Engineers of Great Britain; President Henri Abraham, of the Society of Electrical Engineers of France; President Luigi Luiggi, of the Society of Civil Engineers of Italy, and President Arthur Surveyer, of the Engineering Institute of Canada. On the second day the degree of doctor of philosophy was conferred upon President James R. Angell, of Yale University; President Edward A. Birge, of the University of Wisconsin; President Samuel W. Stratton, of the Massachusetts Institute of Technology, and President Livingston Farrand, of Cornell University; the degree of doctor of science on Albert A. Michelson, president of the National Academy of Sciences, and the degree of doctor of engineering on Carl E. Grunsky, president of the Amer-

ican Society of Civil Engineers; Frederick R. Low, president of the American Society of Mechanical Engineers; William Kelly, president of the American Institute of Mining and Metallurgical Engineers, and Farley Osgood, president of the American Institute of Electrical Engineers.

THE celebration of the connection with the department of chemistry for fifty years of Dr. Edward S. Hart takes place at Lafayette College from October 16 to 18. The first part of the celebration will be in connection with the college Founders' Day exercises commemorating the centennial of the college on the morning of October 16. The remainder of the program will be under the auspices of the Lehigh Valley, New York, Philadelphia, Wilmington and the south Jersey sections of the American Chemical Society.

DR. HARVEY W. WILEY will be the guest of honor at a dinner to be given on October 20 in connection with the meeting of agricultural chemists in Washington. On October 18 Dr. Wiley will celebrate the eightieth anniversary of his birth.

THE French government has conferred the Cross of Chevalier of the Legion of Honor on Dr. Frederick G. Novy, professor of bacteriology and director of the hygienic laboratory of the University of Michigan.

FRANCIS F. LUCAS, of the Western Electric Company, was awarded the Howe gold medal at the annual dinner of the American Society for Steel Treating, for "having written during the past year the best paper on the scientific treating of steel."

PROFESSOR CHARLES LANE POOR, of Columbia University, has been appointed chairman of a committee from the New York Yacht Club to attend the International Conference on Yacht Measurement, which meets in London on October 16.

DR. S. P. L. SÖRENSEN, of the Carlsberg Laboratories, Copenhagen, was recently elected an honorary member of the American Chemical Society.

SIR CHARLES A. PARSONS, chairman of the Parsons Marine Turbine Co., of London, and Senator Luigi Luiggi, president of the Society of Italian Engineers, were given a luncheon at the Engineers Club of New York, on September 26.

DR. NICHOLAS KOPELOFF has returned to the Psychiatric Institute, Ward's Island, New York City, to resume his work as bacteriologist, after a year spent at the Pasteur Institute in Paris and other European institutions.

DR. CLYDE H. BAILEY, professor of agricultural biochemistry at the University of Minnesota, and director of the Minnesota State Experimental Flour Mill, has been granted a year's leave of absence from the university to become director of the technical bureau, Biscuit and Cracker Manufacturers Association, with headquarters in Chicago.

DR. WADE WRIGHT, instructor of industrial medicine at the Medical School of Harvard University, has resigned to take up work with the Metropolitan Life Insurance Company, New York.

DR. FREDERICK C. NARR, formerly of Pittsburgh, has been appointed director of the pathologic laboratories of the Research Hospital at Kansas City.

HENRY G. BERGER, formerly a member of the research staff of the Pittsburgh Experiment Station of the U. S. Bureau of Mines, has been appointed research chemist in the insulation division of the Armstrong Cork Co., Gloucester, N. J.

THE trustees of Radcliffe Observatory, Oxford, have appointed Harold Knox-Shaw, of Trinity College, Cambridge, formerly head of the observatory at Helwan, Egypt, to be Radcliffe Observer in succession to the late Dr. A. Rambaut.

PROFESSOR H. KOPFF, of the Heidelberg Observatory, has been appointed professor of theoretical astronomy in the University of Berlin and director of the Astronomischen Recheninstituts.

PROFESSOR F. PASCHEN, of the University of Tübingen, has accepted the directorship of the Reichsanstalt and will accordingly not be able to lecture at the University of Michigan this semester, as previously announced. A cable to this effect was received on September 22.

DR. JOSEPH F. ROCK, botanical explorer for the Arnold Arboretum of Harvard University, who recently returned from an expedition into the interior of China, is leaving the United States to continue his explorations in these regions. Dr. Rock expects to be away for three years.

A LUNCHEON in honor of Vilhjalmur Stefanssen, the explorer, who has returned to this country after several months in Australia, was given recently in New York. Mr. Stefansson opened his lecture tour in San Francisco on October 6, and next year will again leave for Australia to resume his explorations. He will also go to South Africa to study the deserts there.

ROALD AMUNDSEN, the Norwegian explorer, has sailed for the United States, where he is to make a lecture tour.

DR. THORVALD MADSEN, director of the Danish Serotherapeutic Institute, Copenhagen, will give the Cutter lecture on preventive medicine at the Harvard Medical School on October 14. The subject of the

lecture will be "Whooping cough: its bacteriology, diagnosis, prevention and treatment."

Professor Henri Abraham, director of the physics laboratory at the University of Paris, gave a public lecture on the evening of September 25 at the Carnegie Institute of Technology in Pittsburgh on the subject of "Measurement of time." An audience of 350, including a large number of scientific men, attended the lecture.

The California Academy of Sciences announces a special course of four lectures on "The ways of nature" to be given by Dr. David Starr Jordan, chancellor of Stanford University, in the Auditorium of the Academy's Museum in Golden Gate Park, at three o'clock on Sunday afternoons beginning on October 8.

A memorial to Lord Lister was unveiled on September 20 in Kelvingrove Park, Glasgow, Scotland. It is a seated figure in bronze by the sculptor George Henry Paulin.

At the conclusion of the opening ceremony of the sixty-ninth annual exhibition of the Royal Photographic Society held at the rooms of the society in London, a memorial portrait in bronze of Henry Fox Talbot was unveiled in the library. Mr. Talbot was one of the pioneers of photography, and was the inventor of a process by which positives are obtained from negatives.

Miss Clara Ludlow, of the Army Medical Museum, known for her work on disease-bearing mosquitoes, died on September 28, aged seventy years.

Dr. Sidney Martin, F.R.S., physician to University College Hospital, London, and distinguished for researches in chemical physiology and pathology, died on September 22, aged sixty-four years.

Dr. Franz Doflein, emeritus professor of zoology and comparative anatomy in the University of Breslau, died on August 26, at the age of fifty-one years.

According to the *Journal of Terrestrial Magnetism* there have been held recently in Russia various meetings and conferences relating to the furtherance of geophysical work in Russian countries. Professor P. Lasareff, of the University of Moscow, has been appointed president of the Magnetic Commission, which has for its purpose the continuation of the magnetic survey of Russia and its dependencies.

The New England Intercollegiate Geological Excursion will be held in the vicinity of Brown University, Providence, on October 10 and 11. The carboniferous series including the coal deposits will be studied, also the metamorphic rocks, the shore lines and the glacial geology.

According to the *Journal of the American Medical Association* the fifty-third annual meeting of the American Public Health Association will be held in Detroit, from October 20 to 23, under the presidency of Dr. William H. Park, of New York. Dr. T. Madsen, chairman of the Health Section of the League of Nations, will address the first general session Monday evening, October 20. The second general session, on October 22, will be presided over by the Forum Committee of the association; the third, on Wednesday, will be a symposium on "Values in public health." Dr. George F. Dick, of Chicago, among others, will address the public health administration section. There are nine sections in the association, each of which will be addressed by a number of prominent men. Dr. R. M. Olin, state health commissioner of Michigan, is chairman of the local committee arranging for the meeting. The American Society of Civil Engineers will hold a meeting directly following the meeting of the American Public Health Association and a joint session between the sanitary engineering divisions of both organizations has been arranged.

The fall meeting of the New England Federation of Natural History Societies was convened at Taunton, Mass., on September 26–27, the federation being the guest of the Bristol County Academy of Sciences. Sessions were held at the Taunton Public Library with an evening meeting at a neighboring church. The speaker of the evening was Mr. A. C. Bent, of Taunton, who outlined, with lantern illustrations, a recent exploring trip across Arizona, the purpose of which was the study of birds and plants. At the business meeting on September 27, Norman Easton, president of the Fall River Natural History Society, presented some of the problems confronting small societies in the less important cities. Specialization, he said, makes it difficult for a general society to maintain its interests, while the automobile has had its effects on outings. It was shown by others that, while the matter is not as yet definitely systematized, the automobile may be very useful in carrying a party to the field for collecting or observation. At present this needs much planning, but in general, according to the experience of the Rhode Island Field Naturalists Club, it may be done even with large parties, its recent outing to the bird reservation at Kingston, R. I., some forty miles from Providence, being a case in point. Saturday morning, September 27, was devoted to the gathering of mushrooms, which were exhibited during the afternoon. In the afternoon James H. Emerton, of Boston, read the roll-call of societies, some fifteen of which were represented. John Ritchie, of Malden, presided.

The first international conference of research men

in the sugar cane industry was brought together at the Pan-Pacific Food Conservation Conference at Honolulu, July 28 to August 14, under the auspices of the Pan-Pacific Union. Representatives at the sugar conference were present from Australia, Fiji, Formosa, Japan, Philippine Islands, India, Java, Chile, Mexico, Porto Rico, Cuba, the continental United States and the Hawaiian Islands. The meeting was considered so fruitful by those in attendance that a permanent organization to be called the International Society of Sugar Cane Technologists has been perfected. The purpose of the society as outlined in the constitution is as follows: "An organization to promote by means of triennial conventions the discussion of problems connected with sugar production in both field and factory." Officers elected for the present triennial term were Hamilton P. Agee, of Hawaii, as general chairman and M. S. Barnett, of Australia, as general secretary; H. Atherton Lee was appointed assistant secretary. The next meeting of the society will be held in Havana, Cuba, in February, 1927.

WE learn from *Nature* that the first conference of the Pathological and Bacteriological Laboratory Assistants' Association was held from September 1 to 5, in the department of pathology of the University of Edinburgh. The attendance was good, there being members present from all parts of Great Britain and also from Africa. The local organization was in the hands of a committee appointed by the Scottish division of the association. Lectures and demonstrations in laboratory technique were held, an exhibition of laboratory work and apparatus was on view and places of interest in and around Edinburgh were visited. Members of the Scottish division of the association were responsible for the exhibition, while the London division showed objects of tropical interest and demonstrated specimens illustrating the life history of parasites and their insect hosts. At the dinner on September 5, the president, Professor A. E. Boycott, made the presentation of the first Woodhead medal to Albert Norman together with an address. This medal has been established by means of funds collected among members of the association in memory of the late Sir German Sims Woodhead. In all, £141 has now been received and the subscription list is soon to be closed.

A GENERAL discussion on the physical chemistry of igneous rock formation is to be held in the rooms of the Geological Society of England, London, on October 22. The meeting is being organized under the joint auspices of the Faraday Society, the Geological Society and the Mineralogical Society. A general introduction will be contributed by Dr. J. S. Flett, and papers are expected from Professor C. H. Desch, Dr. J. W. Evans, Professor J. W. Gregory, A. F. Hallimond, Professor Paul Niggli, Dr. A. Richardson, Dr. A. Scott, G. W. Tyrrell and Dr. W. E. S. Turner.

A LARGE collection of natural history material and Indian artifacts has been given to the Oregon Agricultural College, by the heirs of the collector, the late Dr. J. L. Hill.

THE California Academy of Sciences has received by the will of the late Henry M. Holbrook a collection of Lepidoptera of several thousand specimens, and the sum of $2,000 in cash with which to meet the cost of installation.

THE corner-stones of the Todd Memorial Clinic and the Cancer Institute at the university hospitals, University of Minnesota, were laid on October 1.

DEAN E. D. MERRILL, of the University of California College of Agriculture, has recommended the transfer of the Division of Citriculture and Subtropical Horticulture from Berkeley to the Citrus Experimental Station at Riverside, California.

THE Council of the Zoological Society of London has instituted an Aquarium Research Fellowship of the annual value of £350, tenable for one year, but with the expectation of reappointment for two further years if satisfactory progress is being made.

THE formal opening of the Ramsay Laboratory of Chemical Engineering at University College, London, instituted in 1923 as part of the memorial to the late Sir William Ramsay, will take place in November. A full course of study in chemical engineering will be provided in the laboratory in the coming session, leading to the degrees of M.Sc. or Ph.D. in chemical engineering. The course is designed to meet the demands of the manufacturing industries for men trained in the application of scientific methods to the design and operation of industrial chemical processes and plant. Special facilities are provided for research.

UNIVERSITY AND EDUCATIONAL NOTES

ONE million dollars has been pledged to the Hampton Normal and Agricultural Institute, Virginia, and the Tuskegee Normal and Industrial Institute, Alabama, by the Rockefeller General Education Board on condition that the trustees of the two schools raise an equal amount.

CATHOLIC UNIVERSITY, Washington, has received a gift of $750,000 from John K. Mullen, of Denver, which is to be used for a library building.

THE new Goessmann Laboratory of Chemistry at the Massachusetts Agricultural College, erected at a

cost of $300,000 and now almost completed, was dedicated on October 3. The laboratory is named for the first professor of chemistry at the college.

DR. HENRY PAGE, dean of the school of medicine at the University of Cincinnati, has resigned.

AT Harvard University Dr. Frank H. Lahey, professor of clinical surgery, and Dr. Roger I. Lee, Henry K. Oliver professor of hygiene, have resigned.

DR. LEE PAUL SIEG, professor of physics at the State University of Iowa, has been appointed head of the department of physics at the University of Pittsburgh, in the place of Dr. Jay H. Clo, who has resigned to accept a research position with the J. E. Shrader Company, of New York. Dr. Richard Hamer, of the University of Wisconsin, and Dr. W. N. St. Peter, of the University of Michigan, have been appointed assistant professors in the same department.

DR. G. A. TALBERT, formerly associate professor of physiology at the University of Nebraska Medical School, has become professor of physiology at the University of North Dakota.

DR. CARL OTTO, of the University of Cincinnati, has been appointed assistant professor of chemistry at the University of Maine.

DR. H. N. CALDERWOOD, JR., of the United States Forest Products Laboratory in Madison, has been appointed assistant professor of chemistry at the University of Wisconsin.

DR. M. J. ZIGLER has been elected assistant professor of psychology at Wellesley College.

ASSISTANT PROFESSOR W. L. G. WILLIAMS, of Cornell University, has been appointed assistant professor of mathematics at McGill University.

DR. ARCHIBALD YOUNG, professor of surgery and dean of the Anderson College of Medicine, Glasgow, has been appointed Regius professor of surgery in the University of Glasgow, in succession to the late Sir William Macewen.

DR. MAX v. GRUBER, professor of hygiene and bacteriology at the University of Munich, has resigned, and Professor Paul Uhlenhuth, of the University of Freiburg, has been appointed to take his place.

DISCUSSION AND CORRESPONDENCE

AN UNPUBLISHED METRICAL EPIGRAM BY JAMES RUSSELL LOWELL

DURING the "renaissance of New England," Jeffries Wyman, Harvard's gifted anatomist, enjoyed the friendship of famous *literati*. Among his papers there is a battered photograph of bones, on which he had written—"From Prof. J. R. Lowell." Professor Lowell had doubtless felt able to part with it, but first inscribed on it elegiac couplets in German script, suggested by the picture, and of interest to its recipient. The photograph was issued by Hermann Kron, of Dresden, and shows, against a draped background, a well-posed skeleton of a powerful lion; a human skull, on the floor beneath the lion, marks the proportions of a puny race.

These are the verses which Lowell wrote:

> Mäste dein Vieh in geeigneter Art mit erleuchtendem Phosphor—
> Weiser als Moleschott wirds, triffst du das richtige Mass.
> Giebst du zu wenig, so folget der Fluch entsetzlicher Dummheit,
> Aber ein Gran zu viel—! Siehe dies Löwenscelett!!![1]

The reference is to the celebrated physiological chemist, Jacob Moleschott (1822–1893), who concluded the chapter on "peas, beans and lentils" in his *"Lehre der Nahrungsmittel—Für das Volk"* with some luckless and immortal comments. The brain can not exist without its phosphorus-containing fat, he said, which may be built up from the phosphorus in meat, bread and peas, or obtained preformed in fish and eggs. He rambles on:

> So it is jokingly remarked that a wise man has much phosphorus in his brain. No scientist would mean it seriously. For the composition of an organ suffers as much from excess as from deficiency . . . and therefore great thinkers avoid superfluous phosphorus. Yet it is true:—without phosphorus, no thought.[2]

William James disposes of the matter in his "Principles of Psychology,"[3] and introduces Agassiz, the friend of Wyman and Lowell, in this passage:

> "Ohne Phosphor, kein Gedanke" was a noted war-cry of the "materialists" during the excitement on that subject which filled Germany in the '60s. The brain, like every other organ of the body, contains phosphorus, and a score of other chemicals besides. Why the phosphorus should be picked out as its essence, no one knows. It would be equally true to say "Ohne Wasser kein Gedanke," or "Ohne Kochsalz kein Gedanke;" for thought would stop as quickly if the brain should dry up or lose its NaCl as if it lost its phosphorus. In America the

[1] They may be freely translated:

Fodder your beasts in a suitable way with light-giving Phosphorus—
Wiser than Moleschott, they,—granted the dose be correct.
Feed them too little, you blight them, and make of them stupidest asses;
Give but a grain too much—! See them all burnt to a bone!!!

[2] Zweite Auflage. Erlangen, 1853, S. 120.

[3] N. Y., 1890, Vol. 1, p. 101.

phosphorus-delusion has twined itself round a saying quoted (rightly or wrongly) from Professor L. Agassiz, to the effect that fishermen are more intelligent than farmers because they eat so much fish, which contains so much phosphorus. All the facts may be doubted.

Mark Twain, in 1875, was perhaps more humorous than he realized, when he placed whales with fishes in this "Answer to Correspondents":

Young Author.—Yes, Agassiz *does* recommend authors to eat fish, because the phosphorus in it makes brains. So far you are correct. But I can not help you to a decision about the amount you need to eat—at least, not with certainty. If the specimen composition you send is about your fair usual average, I should judge that perhaps a couple of whales would be all you would want for the present. Not the largest kind, but simply good, middling-sized whales.

"American humor is nearly as ephemeral as the flowers that bloom in the spring," writes Aldrich. "Each generation has its own crop, and that of 1860, were it to break into blossom at the present moment, would probably be left to fade upon the stem." But some, perhaps, would regret to lose what has here been recorded of Lowell. As to Mark Twain, he "is not to be classed with the fragile plants."

Frederic T. Lewis
Harvard Medical School

AS STUDENTS UNDERSTAND IT

In Science of August 29, Professor Ellison A. Smyth, Jr., gives an amusing series of student blunders and carelessness in relation to facts of biology. These plainly show that the persons in question knew nothing and cared less for the work required of them.

But does it not illustrate still more plainly "the dry rot of academic biology" and the misuse of the lecture system?

In his admirable autobiography, Professor Pupin criticizes the University of Cambridge for giving him "information" when he needed "contact." Information is what the usual "lecture courses" give, and what the conventional examination asks for, from which the average student gains nothing. Such information is, in general, mechanically given, imperfectly understood by the student, and soon dismissed from his mind.

The results of contact may be permanent. Only by direct relation to things as they are can any healthy teaching in biological subjects be attained. This was clearly shown by word and deed by Agassiz, more than fifty years ago. In our day, the impulse he gave is unfortunately dying out. It is not now the fashion, even for the teacher, to know anything in detail and with exactness. Some zoologists have never looked an animal in the face. A university should train men to observe accurately, to think for themselves and with enthusiasm. To give information is a relatively minor matter. The Sunday newspaper attends to this.

There are two main justifications for college lectures on science. One is to bring together in unified relation facts developed in the laboratory. The other is to develop enthusiasm, "to give inspiration," as the phrase is. To make such lectures worth while the teacher himself must have a degree of inspiration, with skill in making his words connect with the ideas already possessed by his audience.

The student who has handled a reptile or two will not write: "Reptiles have two or more pairs of limbs, such as the locust and others."

Nor will one who knows a bacillus at sight say: "Bacteria are used when vaccinating a person for disease; again they are used in spraying plants."

The fault in the matter of "senterpedes" and "bile ducks" does not lie with the teaching of spelling in the lower schools, but in the use in college of words which convey no actual meaning. Let us have contact as a basis for information. "It is not enough to tell a student that a magnet attracts iron, he must himself feel it pull."

David Starr Jordan
Stanford University

May I add to those choice "howlers" of Mr. Smyth's in Science of August 29 these two samples.

Mine, however, are not by any bewildered child under stress of examination, but from a printed sermon, written with "The Outlines of Science" open under the preacher's nose, by a doctor of divinity, a graduate of a New England seminary, who has been vice-president of his denominational educational society and trustee of four colleges.

The North Star . . . is said to be moving away from us with incredible rapidity, and yet is so far distant that it has seemed to change its relative position but a very little in a thousand years.

Another valuable feature of the spectroscope is its ability to measure the speed of light, even when the light is coming straight toward the instrument. The speed being determined, the distance of the star from which the rays come can be reckoned.

E. T. Brewster
Andover, Mass.

LATIN AS AN INTERNATIONAL LANGUAGE

In reference to the letter of Professor Roland G. Kent about the use of Latin as an international auxiliary language, published in Science for June 20, 1924, pp. 554–555, may the attention of your readers be called again (see Science for April 11, 1919, Vol.

49, pp. 356–357) to "Interlingua" or "Latino sine flexione" proposed by Professor Peano of Turin University, president of the "Academia pro Interlingua"? Many believe that Interlingua has all advantages of Latin without its drawbacks. A quotation from one of the circulars of the "Academia" follows:

INTERLINGUA sive LATINO SINE FLEXIONE

Hodie quasi omni auctore scribe in proprio lingua nationale. Multitudine de linguas in labores de interesse commune ad toto humanitate constitue magno obstaculo ad progressu. Ex patiente studio de intelinguista resulta evidente quod linguas de Europa habe numeroso vocabulo commune. Vocabulario internationale es in quasi totalitate latino, graeco incluso, et es documento de historia de nostro civilizatione. Grammatica pote es reducto ad pauco aut nihil. Plure anno de studio non suffice pro posside latino aut alio lingua nationale, pauco hora suffice pro lingua internationale. Interlingua es intelligibile ad primo viso aut quasi.

Some pamphlets on the question are available for distribution to any of your readers interested in the subject.

A. Fanti

Bureau of Standards,
Washington, D. C.

PALEOLITHIC AND NEOLITHIC OBJECTS FROM EUROPE

The undersigned has been granted a sabbatical year and sailed for Europe on September 13. He expects to visit prehistoric and neolithic sites in France, Belgium, England and Italy. During his travels he will secure from archeologists, museums or collectors type specimens illustrating the life of primitive man in these various countries. Two or three museums have asked him to obtain for them small exhibits. Readers of Science or museum curators who may desire European objects will please communicate with him at the below address and his secretary will forward the communication.

Warren K. Moorehead

Department of Archeology,
Phillips Academy,
Andover, Mass.

SCIENTIFIC BOOKS

La Géologie Sismologique, Les Tremblements de Terre, Avec une préface de M. Pierre Termier, Membre de l'Institut. By Comte Fernand de Montessus de Ballore. Colin, Paris, 1924, pp. xiv and 488, 14 pls. and 114 figs.

The posthumous appearance of the Count de Montessus's "La Géologie Sismologique" marks the completion of the seismologic trilogy, the first volume of which, "Seismic Geography," first saw the light in 1906 and was quickly followed by "Seismic Science" in 1907. With singleness of purpose the Count has pursued his studies throughout more than a score of years and was busy reading the proofs of this completing volume when he was stricken with his fatal illness. Undeterred, he continued to labor upon these proof sheets with his accustomed ardor until the very day of his death, nearly three weeks later.

Together these three massive volumes, well organized and written in a clear incisive style, comprise what is now known of the science of seismology. They stand alone in their field as a comprehensive work of generalization, and are likely long to remain so. When nearly a half century ago the Count was a resident of San Salvador on a military mission and first turned his attention to the earthquakes which so frequently racked that country, it could hardly be said that a science of seismology existed. The misguided centrum theory of earthquakes, due to Robert Mallet and dating from 1862, explained earthquakes as occasioned by an explosion of gases within a subterranean chamber (centrum), and the brilliant system of the Dutch physicist, Huyghens, had been cleverly made use of to follow the vibrations sent out from the supposed centrum. By many, however, earthquakes were still supposed to have their cause either in the atmosphere or in the changes of the moon. The part which the Count's own studies have had in dispelling all these erroneous notions is a dominating one.

In his "Seismic Geography" de Montessus showed on the basis of a comprehensive statistical study of the earthquakes of history, that about 95 per cent. of all known earthquakes have occurred within two great-circle belts, one circum-Pacific and the other intersecting the first at an angle of about 67 degrees and taking its course through Malaysia, the Mediterranean and the Caribbean. These zones de Montessus recognized as the Mesozoic geosynclines and as the belts of growing mountains of Tertiary and later periods. Such definite localization of earthquakes probably gave somewhat too great prominence to these belts and overemphasized a supposed immunity of the regions outside. Heavy earthquakes have indeed occurred in a few instances in the outside areas, such for example, as the great earthquake of the St. Lawrence Valley, February 5, 1663, the New Madrid earthquake of 1811 within the Lower Mississippi Valley, and the Charleston earthquake of 1886.

In his concluding volume, "Seismic Geology," the Count sets up a modified classification of earthquakes, apparently so as to include these neglected regions which have greater stability but lack entire immunity. He distinguishes two main classes: (I) glyptogenic

or geologic earthquakes, and (II) external dynamics earthquakes, which include volcanic and landslide earthquakes, both relatively unimportant. Under (I) are to be found practically all the great earthquakes of history, and these de Montessus subdivides into (1) epeirogenic, (2) tectonic or orogenic earthquakes and (3) epeirogenic and tectonic earthquakes.

The reviewer believes that neither in its plan nor in the allocation of individual earthquakes is the Count's classification satisfactory. The fact that the earthquake of Casamicciola (Ischia) in 1883 was centered on the flanks of the volcano of Epomeo does not show that it was volcanic in origin, for Cassamicciola is well known to lie at the intersection of dislocation lines. It is also difficult to understand why the earthquake of Assam in 1897 or various Chilian earthquakes should be placed in the epeirogenic class, since they occurred either within or close to the zones of mountain growth. The reviewer believes, moreover, that it will in most cases be found impossible to determine in how far epeirogenic movements in the sense employed by de Montessus may or may not be combined with orogenic ones; and that it would have been both simpler and more nearly correct to make of the glyptogenic (better, tectonic) class two subdivisions only, one called orogenic and connected with mountain growth, and the other epeirogenic and not so connected but related to block faulting *per se.*

The Count's isolation, because of his residence in Chili during the last eighteen years of his life when he was preparing the "Seismic Geology," imposed a handicap which was to a large extent overcome by his wide correspondence, by his large personal library and by his intimate familiarity with many European languages.

WILLIAM HERBERT HOBBS
UNIVERSITY OF MICHIGAN

LABORATORY APPARATUS AND METHODS

A CULTURE TUBE FOR USE WITH COLLODION SACS

IN the course of recent studies of bacteria, the associated growth of gas formers and non-gas formers was under observation. It was desirable to cultivate the organisms in the same medium separated by a collodion membrane. After several tests, the method of preparing permeable membranes, as described by Gates,[1] was followed. This method, if carefully followed, gives excellent results.

For anaerobic non-gas formers the V-shaped glass tubes as designed by Gates[2] were used. This apparatus, however, is unsuitable for cultures of gas formers. To meet the conditions of these gas producers it was found desirable to develop an apparatus as shown in Fig. I.

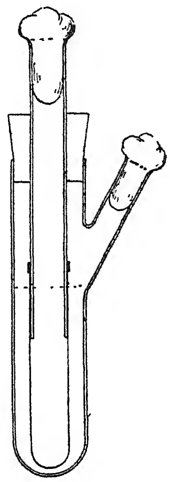

FIG. 1

The illustration shows a simple arrangement for the culture of bacteria and other micro-organisms on opposite sides of a collodion sac. These tubes have also been found convenient in experiments where a membrane is interposed between solid bodies and bacterial cultures as in the Noguchi method. They are convenient to handle and may be inserted into the common type of test tube stand. The side arm of the tube affords an easy means of inoculating culture media or withdrawing solutions from outside the sac, while material inside the sac may be reached through the glass supporting tube to which the sac is attached. These tubes may be used with either a rubber stopper or a cotton plug carefully fitted to the supporting tube and pressed into the larger tube.

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MADISON, WISCONSIN

[1] Gates, F. L., *Jour. Exp. Med.*, XXXIII, 25 (1921).
[2] Gates, F. L., *Jour. Exp. Med.*, XXXV, 635 (1922).

CADAVERA WITH FLEXIBLE JOINTS

THE rigidity of the joints of the cadaver as ordinarily prepared impedes the progress of the dissection. In the study of muscle action it is especially desirable to have a flexible specimen. In such a specimen the orifices of the body may be approached naturally. Any method resulting in flexibility should be of ready application and preferably should call for no great alteration in the preserving fluids used.

For the past thirty months the following simple method has given us satisfactory results. Upon bringing the cadaver into the embalming room the joints are manipulated so as to secure free and complete mobility. By steady traction each joint is once com-

pletely carried through its characteristic movements and counter movements. This produces the maximum lengthening of the muscles acting upon the joint. This lengthening is permanent.

It is now only necessary to use a fluid that will not make the joint capsule rigid. This means that liquor formaldehyde (U. S. P.) can not be used, for as little as 500 cc per cadaver produces rigidity. The fluid we use in this laboratory, like the majority of those fluids used in this country, consists of varying mixtures of phenol (pure crystalline), alcohol and glycerine.

Rigor mortis when present ordinarily does not interfere with the mobilization of the joints. Very muscular cadavera may be conveniently left at room temperature over night so that the rigor may subside. The entire manipulating of the body, including the mobilization of the vertebral column and the temporomandibular joint, does not require more than ten minutes. Torn muscles have not been found in the dissection of over one hundred cadavera prepared by this method. It is of course possible to obtain similar results by using an arsenic fluid without manipulation; however, arsenic fluids are at present not in favor as preserving media for routine class material.

O. V. Batson

Department of Anatomy,
University of Cincinnati

SPECIAL ARTICLES

THE SURFACE EQUILIBRIUM OF COLLOIDAL SOLUTIONS. II

Antagonistic Action of Colloids

When a trace of powdered sodium oleate is added to pure water or to a salt solution contained in a watch-glass, the surface tension decreases instantaneously and becomes very small. If the amount of sodium oleate added is smaller than (1/1,000), the drop will continue for over one hour until a certain minimum value is attained. This value will then remain practically constant.[1] But when the same amount of sodium oleate is added to the same watch-glass containing some other colloid in solution, instead of pure water or saline, the surface tension, after reaching instantaneously its bottom value, starts up immediately and in a few minutes, according to the concentrations, tends towards its original value or even reaches it. Of course, if the amount of sodium oleate (or any other strongly surface active colloid, such as sodium glycocholate) is too large, the final value will be smaller than the original value of the surface tension of the solution. The same thing will happen if the amount of the second colloid (antagonistic) is too small. Table I shows the results of one experiment.[2]

TABLE I

Rise of Surface Tension of Serum in Function of Time after a Drop Due to the Addition of Sodium Oleate

Pure Dog Serum, No. 1

Temperature 22° C.

About 1/10,000 in weight of powdered sodium oleate was used.

Time	Surface tension dynes
Before addition of sodium oleate	57.5
After addition of sodium oleate	39.0
After 15 seconds	44.0
After 30 seconds	48.0
After 1 min.	51.0
After 1.5 mins.	52.5
After 2 "	53.5
After 3 "	55.0
After 4 "	56.8
After 5 "	57.3
After 6 "	57.6
After 9 "	58.0
After 20 "	57.6

After having dropped from 57.5 dynes to 39.0 dynes (18.5 dynes drop) instantaneously, it comes back to 57.5 in less than 6 minutes. When the phenomenon is plotted in function of the time, it gives a very smooth logarithmic curve. Of course, in order to study this phenomenon, it is clear that the Tensiometer[3] previously described must be used, since measurements of the surface tension of the *same* layer of liquid are required at least every minute.

As far as we could see, this phenomenon is general for all colloids studied. In other words, the less surface-active colloid will tend to adsorb the more active colloid so as to counteract, sometimes completely according to their nature and relative concentration, the effect of the second on the surface tension of the solution. This explains why, in jaundice, relatively large amounts of sodium glycocholate and taurocholate can exist in the circulation without causing hemolysis of the whole blood.

II

Action of Colloids on the Crystallization of Salts

It has been shown in a previous paper[4] that col-

[1] du Noüy, P. L., "Surface Equilibrium of Colloidal Solutions. I.," Science, 1924, Vol. LIX, No. 1539, p. 580.

[2] *Compt. rend. Acad.*, 1922, clxxiv, 1258; *Compt. rend. Soc. biol.*, 1924, lxxxix, 1148.

[3] du Noüy, P. L., *J. Gen. Phys.*, 1919, i, 521; *La Nature*, 1920, No. 2391, p. 63. Holmes, H. N., "Manual of Colloidal Chemistry," New York, Wiley, 1922.

[4] du Noüy, P. L., *J. Exp. Med.*, 1922, xxxv, 732; *Compt. rend. Acad.*, 1922, clxxiv, 963.

loids in solution will become adsorbed in the surface layer in function of the time. When salts, NaCl, for example, are contained in the solution, the dissociated ions are adsorbed on the micellae or molecules of the colloid, and carried to the surface of adsorption, thus decreasing to a considerable extent the concentration of salts in the solution. In other words, when colloids are present with salts in a solution, the concentration of salts in the bulk of the liquid, according to Gibbs's law, does not occur. On the contrary, the salts are concentrated in the surface layers, together with the colloids. This explains the precipitation of colloids at interfaces and the formation of membranes.[4] The experimental illustration of this fact is made as follows:

Solutions of different colloids (serum, albumins, gum arabic, saponin, dyes, etc.) are prepared in saline solution (NaCl 0.9 per cent.). The following concentrations are then placed in watch-glasses, carefully cleaned: 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and intermediate values up to 10^{-7}. Pure NaCl solution is also placed in watch-glasses as a control. After evaporation, the pure saline solution shows large, well-formed NaCl crystals at the bottom of the watch-glass, while the watch-glasses containing the colloids exhibit a large opaque white disk, with a dark area in the center. The white disk is made of minute NaCl crystals, so small as to give the impression of smooth white paint. At the bottom, instead of large crystals, a few small scattered crystals are seen, showing that the crystalloid could not concentrate in the bulk. The diameter of the white disk is almost that of the solution before evaporation, showing that, as it evaporated, the liquid abandoned progressively on the glass the colloid and the salt concentrated in the surface. The phenomenon with saponin is very clear up to a concentration of saponin of 1×10^{-7} gms per cc (1/10,000,000), and with proteins up to (1/4,000,000) (NaCl concentration of 1 per cent.).

At a given concentration (10^{-2} for serum, 10^{-3} for saponin and sodium oleate), periodic rings consisting of small crystals are observed on the watch-glass, a little over 1 mm apart. These experiments show very clearly the adsorption of crystalloids by colloids in the same solution.

P. LECOMTE DU NOÜY

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

BREEDING HABITS AND MUTATIONS IN THE MOTH-LIKE FLY (PSYCHODA)

DURING the last eighteen months I have been engaged in studying the breeding habits and life history of a moth-like fly (Psychoda alternata) with the view of determining whether the form might not be used in studies in genetics. The effort has been attended with unusual success both in breeding the flies and in the discovery of at least one mutation.

Culture methods and life history: The adults are minute, hairy animals about two millimeters in length. They ordinarily breed in decaying vegetation, but dung from either horses or cattle has proved to be an excellent medium. Breeding takes place readily under laboratory conditions, the life cycle being completed in from twelve to sixteen days. Adult females are favorably stimulated by the culture medium, so that ovipositing takes place quickly. The eggs hatch in a little less than two days into active, eyed larvae resembling those of midges. The larvae feed for about ten days, after which they become quiescent and pupate. Adults emerge two days later and complete the life cycle.

Pedigreed strains are being maintained in test tubes and small flasks, while battery jars are being employed for large mass cultures.

A second species of moth-like fly (psychoda minuta) is being bred successfully under conditions similar to but somewhat more difficult than the first.

Mutations: Several mutations have appeared which reoccur regularly and a number of fluctuating variations have been induced by altering conditions of temperature and moisture. The most striking mutation has been studied in detail especially as to its method of inheritance, and it has been found to behave as a simple Mendelian recessive. The normal, wild fly has a reddish-brown pigment in the lens of each ommatidium, giving a reddish-brown color to the entire compound eye. The pigment is also found in the Malpighian tubules from the earliest stage in which the tubules may be distinguished and the ocelli of the larvae are also colored reddish-brown. In the mutant the pigment is lacking, so that the adults are white-eyed except for the pigment between the ommatidia and colorless Malpighian tubules appear in larvae, pupae and adults. The larvae also have colorless ocelli. This mutation breeds true and has been carried through forty-eight generations with no indication of a return to the normal condition.

Two other mutations have appeared and their methods of inheritance are being studied.

Because of the ease with which this fly is bred and handled, its short life history and its possibilities in the production of mutations it is predicted that the form will become very useful in the study of heredity.

Articles with figures and photographs are being prepared dealing with the life history and culture methods, with the white-eyed mutation and its method

of inheritance and with the phototropic reactions of the normal and mutant flies.

ZOOLOGICAL LABORATORY, BELOIT COLLEGE
C. L. TURNER

THE IOWA ACADEMY OF SCIENCE

THE thirty-eighth annual meeting of the Iowa Academy of Science was held at the Iowa State College, Ames, Iowa, May 2 and 3, 1924. The associated societies, Iowa Section, Mathematical Association of America, Ames and Iowa Sections of the American Chemical Society, and the Iowa State College Branch, Society of American Bacteriologists, held their sectional meetings in connection with the Academy.

The meeting was especially commemorative of President L. H. Pammel's thirty-five years of service in the state, and several of the papers and addresses were in review of the scientific work of that period. Special features of the meeting were addresses by Dr. William Trelease, of the Illinois State University, on "Personal recollections of some North American botanists," and by Dr. Herbert Osborn, of the Ohio State University, on "Recollections of early workers in entomology and zoology," a paper on "The early history of the Iowa Academy," by Dr. D. S. Fairchild, of Clinton, and the presidential address by Dr. L. H. Pammel, of the Iowa State College, on "A century of botany in Iowa."

Officers were elected as follows: *President,* O. H. Smith, Cornell College; *vice-president,* R. I. Cratty, State College; *secretary,* P. S. Helmick, Drake University; *treasurer,* A. O. Thomas, State University; *representative to A. A. A. S.,* D. W. Morehouse, Drake University.

The sectional chairmen for the ensuing year are: *Bacteriology,* Paul Emerson, State College; *botany,* H. E. Jaques, Iowa Wesleyan College; *chemistry,* H. F. Lewis, Cornell College; *geology,* W. F. V. Leicht, Simpson College; *mathematics,* E. R. Smith, State College; *physics,* P. S. Helmick, Drake University; *zoology,* Dayton Stoner, State University.

The following papers were presented:

BACTERIOLOGY[1]

(Iowa State College Branch, Society of American Bacteriologists.)

The application of electronic theory in its applications to oxidation-reduction potentials in bacteriology: F. E. BROWN.

The problem of stream pollution in Iowa: H. V. PEDERSON.

Production of hydrogen sulfide by members of the colon group of bacteria: FRED S. PAINE.

Utilization of chinic acid in the differentiation of the colon-aerogenes groups: Demonstration. B. H. BUTCHER.

Some observations on the Voges-Proskauer reaction: CLAIR S. LINTON.

The epizoology of an outbreak of anthrax in Iowa: C. D. RICE.

Nutrose medium as a substitute for sugar-free broth in the study of carbohydrate fermentation: S. H. McNUTT and PAUL PURWIN.

The diagnosis of bacillary white diarrhœa in chicks: CHAS. MURRAY.

Studies on the Morgan group of paratyphoids: JOHN WELDIN and A. G. AJWANI.

Food preservation and so-called "food poisoning": G. G. DEBORD.

The need of organizations of those engaged in laboratory diagnosis: ROSS L. LAYBOURNE.

A proposed grouping of the yeasts common in dairy products: M. P. BAKER.

Variations in the S. lactus group: B. W. HAMMER.

The present status of Wildier's bios: E. I. FULMER.

Theory of dye utilization in bacteriological media: Demonstration. C. H. WERKMAN.

Notes on the fungus flora of Iowa soils: E. V. ABBOTT.

Home economics bacteriology as a field for research: CLARISSA CLARK.

A schematic arrangement for the classification of laboratory media: H. W. SCHOENLEN.

A green nonfluorescent organism isolated from creamery wastes: LULU SOPPELAND.

Acidity as a factor in the purification of creamery wastes: MAX LEVINE and LULU SOPPELAND.

BOTANY

The work of Dr. Pammel at the State College: A. T. ERWIN.

The house fungus, Merulius lacrymans: W. H. DAVIS.

The genus Physalis in Iowa: O. E. ELMER.

Quercitron oak and its relation to soils: RAYMOND J. BECRAFT.

Distribution of plants on upper Skunk River, Iowa: RAYMOND J. BECRAFT.

Ecological notes in the Arapahoe Mountains near Frazer, Colorado: L. H. PAMMEL.

The Uredinales of Iowa: J. C. ARTHUR.

The tropograph and flectograph: WALTER J. HIMMEL.

The physiological barometer: RAYMOND WALLACE.

The physiology of growth: CLIFFORD H. FARR.

Certain features of the vegetation in Kansas sand hills: FRED W. EMERSON.

A ten-years' phenological record of the spring flowering plants: H. E. JAQUES.

Further studies of the germination of woody plants: L. H. PAMMEL and CHARLOTTE M. KING.

Viability tests of stored corn of different ages: MISS CHARLOTTE M. KING.

Comparative anatomy of Hubam and biennial sweet clover: MISS ALICE M. CROZIER.

The Polyporaceae of Iowa: ROBERT E. FENNELL.

Comparative rates of imbibition in apple wood tissue: CHARLES F. ROGERS.

[1] Abstracts of these papers will be found in the *Journal of Bacteriology.*

Lilium michiganense in Iowa: WIER R. MILLS.

At what depth should clover seeds be planted? WINFIELD SCOTT.

What is the absolute value of the prevailing method of selecting kernels from ears of seed corn for testing purposes? PROFESSOR WINFIELD SCOTT.

The morphology of Basidiophora Kellermanii: GUY WEST WILSON.

Notes on some Colorado and Wyoming fungi: PROFESSOR GUY WEST WILSON.

Species crosses in the genus Cucurbita: EDWARD F. CASTETTER.

Iowa plant notes: R. I. CRATTY.

The genus Rumex in Iowa: MR. CRATTY.

Hybrid oaks in Iowa: B. SHIMEK.

Prairie slopes on the bluffs of Mississippi River: PROFESSOR SHIMEK.

Genetic linkage between chlorophyll and carotinoid pigments in maize: E. W. LINDSTROM.

Inheritance of carbohydrates and fat in corn: E. W. LINDSTROM and F. GERHARDT.

General relation of endosperm and chlorophyll characters in maize: W. A. CARVER. (Introduced by E. W. Lindstrom.)

The chemical composition of wheat seedlings: L. EDWIN YOCUM.

Response of the genus Rhamnus to Puccinia coronata Corda: S. M. DIETZ.

Breeding oats resistant to Puccinia graminis avenea: MR. DIETZ.

Some winter flowering plants: WILLIAM POULTER.

CHEMISTRY

(Ames and Iowa Sections, American Chemical Society.)

Physical Chemistry

Adsorption from salt solutions by colloidal copper ferrocyanide: MIKKEL FRANKERT and J. A. WILKINSON.

A method of measuring rates of corrosion: E. LEE HENDERSON, C. E. STANWART and G. H. BRODIE.

Structural evidence of an iron-carbon eutectoid: H. E. FLANDERS and ANSON HAYES.

The solubility in austinite of carbon from carbon and of carbon from cementite: H. L. MAXWELL and ANSON HAYES.

Compressions as a factor in causing deviations of the system alcohol-water from Raoults' law: W. H. JENNINGS and ANSON HAYES.

The physical properties of some "short period anneal" products of white cast iron: ANSON HAYES and W. J. DIEDERICHS.

Determination of the colloidal material in soils: D. VERNE MOSES.

The electrometric determination of lime: H. V. WRIGHT and R. B. MORRIS.

The preparation of activated carbon from furfural residues: GALEN HUNT.

The use of the audion tube in chemical measurements: EDWIN KURTZ.

The free energy of dilution and the activity of the ions in aqueous solutions of barium chloride: J. N. PEARCE and RALPH W. GELBACH.

The partial molal volumes of certain anions of organic acids: J. N. PEARCE and F. E. WARE.

Analytical Chemistry

The effect of pressure on the rate of decomposition of potassium chlorate-manganese dioxide mixtures: F. E. BROWN and H. M. MCLAUGHLIN.

Spontaneous decomposition temperatures of potassium chlorate-iron oxide mixtures: F. E. BROWN and W. C. O. WHITE.

Some increases in potential of calomel electrode-oxidizing agent—platinum electrode cells on adding reducing agents: W. S. HENDRIXSON.

The incomplete oxidation of sulfurous acid by some oxidants: PROFESSOR HENDRIXSON.

A study of the substances in rain and snow: NICHOLAS KNIGHT.

Bio-Chemistry

Feeding potassium iodide to young growing swine: JOHN M. EVVARD.

Some observations on the effect of iodine administration on sheep: J. M. EVVARD, A. R. LAMB, W. G. GAESSLER.

The rôle of rye in the Vienna process for the manufacture of yeast: E. I. FULMER and ROMA ELMER.

Certain maxims to be observed in the study of the nutrition of microorganisms: PROFESSOR FULMER.

Relation of diet to reproduction and rearing of young: L. T. ANDEREGG.

Observations on the nutritive value of skimmed milk powder: PROFESSOR ANDEREGG.

The possibility of a new vitamine for reproduction: V. G. HELLER.

Metabolism and vitamine A: C. MCCAY and V. E. NELSON.

Industrial Chemistry

Effect of natural alkali waters on concrete: GEO. A. BURKE.

Possible uses for waste chlorine: O. R. SWEENEY and J. W. HUSSEY.

The manufacture of oxalic acid from corn cobs: H. A. WEBBER.

Studies on the commercial preparation of chlorates: H. A. CHRISTOPHERSON.

The preparation of zeolytic water softening materials: E. L. BARTHEL.

The bleaching of soy bean oil with peat: H. V. WRIGHT and G. A. PIERCE.

Method of preparing silica absorbents: O. R. SWEENEY, F. PFEFFER and A. L. REDSTONE.

The preparation of permanent porcelain and quartz mats for Gooch crucibles: G. N. QUAM and H. V. WRIGHT.

The preparation of activated carbon from furfural residues: GALEN HUNT.

Chemical engineering and agriculture: JULIAN E. MACFARLAND.

Magnesia crucibles in an arc furnace: Edmond E. Moore and Anson Hayes.

Food Chemistry

Relation of starch to the strength of wheat flour: G. G. Naudain and J. H. Buchanan.

Organic Chemistry

A comparative study of the removal of cotton seed and corn oil stains from wool and silk: Ruth O'Brien and Barbara Wentch.

Action of thionyl chloride on diacetone glucose: J. B. Allison.

Some recent studies concerning organometallic compounds: H. H. Parker, F. Schulze, W. B. King, J. M. Peterson and H. Gilman.

Conclusions in regard to the methylation of phenol: H. F. Lewis and Wesley J. Treesch.

Note on the hydrolysis of benzene: H. F. Lewis and J. W. Thiessen.

The relation of substituents in the hydrocarbon radicals to the formation and reactions of certain mixed ethers: L. Chas. Raiford and J. C. Colbert.

Chemical Education

A simple automatic mercury pump which permits the collection of the exhaust gas: H. M. McLaughlin and F. E. Brown.

Chemistry Department, Iowa State College, its equipment and organization: W. F. Coover.

A comparison of the grades in chemistry made by pupils who were taught by the same instructor in recitation and laboratory with the grades of pupils who were taught by different instructors in recitation and laboratory: F. E. Brown and Kenneth L. Bird.

The content of chemistry courses based on data secured by the Iowa Committee on the Correlation of College and High School Chemistry: P. A. Bond.

A "painless" method for the preparation of chlorine: Jacob Cornog.

Geology and Ethnology

A dust-fall in Iowa on March 29, 1924: Earl T. Apfel.

Geology of the region about Belton in northwestern Montana: Robert H. Seashore.

The Apache region, Arizona and its Indians: (By title) Albert B. Reagan.

An Indian quartzite quarry near Hot Springs, South Dakota: Paul Rowe.

The Algona recessional stages of Wisconsin glaciation in Iowa: John E. Smith.

The Fort Dodge stages in the retreat of the glaciers: Professor Smith.

A preliminary state map of the Wisconsin glacial till: Professor Smith.

Some theoretical stages in the retreat of the Iowan ice sheets: Professor Smith.

The fauna of the state quarry beds: (Illustrations), M. A. Stainbrook and H. S. Ladd.

Notes on the geology of Jackson county: Henry S. Ladd.

The physiography of southwestern North Dakota: Philip B. King (Introduced by A. O. Thomas).

An intra-Cedar Valley unconformity in Johnson county: Walter V. Searight and Max Littlefield.

A light colored zone of subsoil in southern Iowa: W. G. Baker.

The relation of Aftonian peat beds to the Nebraskan gumbotil plain: George F. Kay.

A fossil pine cone from drift of northern Iowa (Illustrations): A. O. Thomas.

Some goniatites from the Paleozoic of Iowa (Illustrations): Professor Thomas.

Pleistocene mammalian remains recently found in Iowa (Illustrations): Professor Thomas.

Ascent of Mt. Namosi, Fiji, (Illustrations): Waldo S. Glock (Read by Professor Thomas).

A section in some late Tertiary and Quaternary marls near De Land, Florida (Illustrations): Thomas H. Macbride (Read by Professor Thomas).

Application of term Pennsylvanian to Iowa Coal Measures: Charles Keyes.

Recent light on the meaning of early Devonian hiatus: Dr. Keyes.

Eastern extension of western deserts in Iowa: Dr. Keyes.

The deep water-well at Brighton: J. M. Lindly.

Mathematics[2]

(Iowa Section, Mathematical Association of America).

Reduction of the equation of the general conic section: W. J. Rusk.

The preparation of high school teachers of mathematics in Iowa: E. W. Chittenden and F. M. Weida.

On the meaning, evaluation and application of the refund integral: F. M. Weida.

The zeros of the function $f_k(z) = \sum_{n=0}^{\infty} n^k \frac{z^n}{n!}$ *where k is a positive integer:* Julia T. Colpitts.

Note on the average family of brothers and sisters of the boys in families of n children: H. L. Rietz.

Relation of surface level of a rotating fluid to the shape of its container: Edward S. Allen.

Determination of the foci and directrices of a conic section: Edward S. Allen.

Construction of the tangents of an ellipse: Edward S. Allen.

A problem in mathematics teaching: F. M. McGaw.

The isobaric differential equation in an elementary course: John F. Reilly.

A new interpolation formula: John F. Reilly.

A theorem in spherical trigonometry: J. S. Turner.

A new property of the circle: J. S. Turner.

A theorem in geometry: Roscoe Woods.

The solution of q-difference equations by means of infinite determinants: E. R. Smith.

Certain transformations of frequency distributions: G. W. Snedecor.

[2] Abstracts of these papers are published in *The American Mathematical Monthly.*

PHYSICS

Rainbow and other atmospheric phenomena: (By title) MRS. F. MAY TUTTLE.

Is Iowa getting wetter or drier? CHARLES D. REED.

A note on daylight requirement: WM. KUNERTH.

Orientation of buildings on the basis of sunlight: PROFESSOR KUNERTH.

Preliminary report on the optical properties of magnesium: M. E. GRABER.

Balmer lines from hydrogen in certain gases: E. O. HULBERT.

On the theory of the refraction of X-rays: PROFESSOR HULBERT.

On the breadth of the hydrogen lines in the stellar spectra: PROFESSOR HULBERT.

The Balmer absorption series of hydrogen: PROFESSOR HULBERT.

The absorption lines in the spectrum of the metallic spark in water: PROFESSOR HULBERT.

Phenomena of cathode sputtering: K. V. MANNING.

Electrical constants of dielectrics for radio frequency: R. V. GUTHRIE.

Torques and forces between coils carrying currents of high radio frequency: T. A. HUNTER.

A note on the theory of x-ray diffraction in liquids and amorphous solids by Raman and Ramana han: E. H. COLLINS.

Magnetic properties of evaporated iron films: A. J. SORENSEN.

The action of a Helmholtz resonator in a branch line: G. W. STEWART.

Measurement of the acoustic impedance of a branch line: PROFESSOR STEWART.

Note on the theory of the optimum angle of a conical horn: PROFESSOR STEWART.

The Hall effect and specific resistance in evaporated films of nickel, cobalt, palladium and platinum: H. B. PEACOCK.

The theory of megaphones and receiving horns: G. W. STEWART and G. R. BUTZ.

The M absorption limits in the tungsten x-ray spectrum: R. V. ZUMSTEIN.

Sparkless discharge of electrified silks and woolens: JAY W. WOODROW.

Maxwell's treatment of networks applied to the delta connection of a three-phase power service: ALFRED W. MEYER.

The relative values of selenium cell and ionization methods of measuring x-rays in Roentgenotherapy: ARTHUR W. ERSKINE AND SCOTT W. SMITH, JR.

A theoretical discussion of the intrinsic intensity and percentage of polarization of light passing through deep slits: L. P. SIEG.

The effect of the material composing the sides of deep slits on the intrinsic intensity of light transmitted through the slits: C. R. SMITH. (Introduced by L. P. Sieg.)

On the optical constants of selenium and of tellurium in the blue and ultraviolet regions of the spectrum: R. F. MILLER. (Introduced by L. P. Sieg).

An experiment in effective resistance as a function of eddy current and hysteresin losses: C. J. LAPP.

New charts of radioactive data: PROFESSOR LAPP.

A search for element 61: MESSRS. HOPKINS, LAPP AND R. A. ROGERS.

Electric arc method of making x-ray targets: MESSRS. LAPP AND ROGERS.

A method for the production of longitudinal sound vibration in a rod: W. D. CROZIER.

A simple method of determining horizontal intensity of the earth's magnetic field: E. P. T. TYNDALL.

GENETICS, PSYCHOLOGY AND ZOOLOGY

Is the quality of our high school students deteriorating? C. C. ROSS.

The content of a course in child study for girls not intending to teach: THOMAS F. VANCE.

The various methods used to examine students and the relative merits of those methods: J. E. EVANS.

Results of the testing program given at State College: MISS NORA KLISE.

The differential death rate of sexes in animals, with a suggested explanation: S. W. GEISER.

Notes on the biology of Eutettix strobi (Homoptera, Cicadellidae): F. A. FENTON.

Arsenical poisoning in tomato plants: PROFESSOR FENTON.

A study of the movements of the empty stomach in the mollusca: T. L. PATTERSON.

The lateral line organs of the shovel-nose sturgeon, distribution and innervation: H. W. NORRIS.

Keeping Iowa's waters pure: GEORGE BENNETT.

A preliminary list of the bees of Iowa—The genus Halictus: RALPH L. PARKER and FREDERICK A. FENTON.

The Odonata of Henry county: CHARLES HOFFMAN.

Birds of Wapello county, Iowa: CHARLES J. SPIKER.

Notes on the Oyster-Shell Scale, Lepidosaphes ulmi Linn: R. L. WEBSTER.

Photochemical distribution on the retina as shown by the perimeter: F. M. BALDWIN.

The effect of vitamin deficiency on blood pressure in rats: H. B. COOK and F. M. BALDWIN.

Snake notes: J. E. GUTHRIE.

Simple versus complex mineral mixtures for young growing swine: JOHN M. EVVARD, C. C. CULBERTSON and W. E. HAMMOND.

Trapping birds at Iowa City during 1923: DAYTON STONER.

The fourth volume of the first edition of Holbrook's "North American Herpetology": B. SHIMEK.

Three different types of genetic sterility in the parasitic wasp Habrobracon: P. W. WHITING. Drawings.

Two generations of selection with reference to the inheritance of scurvy resistance in guinea-pigs: W. V. LAMBERT. Charts.

Results of selective breeding in the parasitic wasp Habrobracon: U. A. HAUBER.

New measurements in the process of reading: E. O. FINKENBINDER.

P. S. HELMICK,
Secretary

SCIENCE

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ONE HUNDRED YEARS OF THE FRANKLIN INSTITUTE[1]

As honorary chairman of the centenary celebration committee of the Franklin Institute, I have been appointed—with no subject assigned—to address you, a circumstance which permits me to deal generally with the past period of one hundred years of the life of the institute. Before doing this, I should like to refer briefly to the significance of such an occasion as this, the bringing together of so much scientific talent and eminence in research as is evidenced in the names of the speakers who are to address the sections, according to the carefully prepared program. The institute is indeed fortunate in having on the list not only many of the most distinguished in our own land, but also exceptional representation from over the seas, the whole forming a body of scientists and engineers such as is seldom if ever brought together on like occasions. The impressive list of representatives of universities and colleges everywhere, the body of leaders in science who are listed as delegates from the learned and professional societies and the numerous company of those from the great industrial organizations together form a gathering of high standing in science, in research and in the technical work which characterizes the age in which we live.

One might wish to be able to add that the age is equally well characterized by the application, in all the activities of life, of at least a semblance of the scientific method of discerning truth from falsity. But there is a strong survival of prejudice, of bigotry and of medieval ignorance in relation to the simple facts of life and existence in this world of ours; a clouding of mind only to be removed by more universal teaching of scientific principles, not alone in physics and chemistry, but in such subjects as biology and its kindred branches, in economics and even in politics and government. The advanced medical investigator still has to deal with the unreasoning prejudice of the anti-vivisectionist, it may be, or vaccinationist, or other anti-what-not, and the usual quackery to be found in the fanciful names for fanciful practice. The naturalist is even at this day threatened, in his conclusions and teaching, by the anti-evolutionist and his kin.

Fortunately, the more fundamental studies of physics, chemistry and the mechanic arts are not so banned or obstructed. The beneficial results are more immediate or direct, and less likely to cast doubt on the

[1] Address at the Centenary Celebration of the Franklin Institute, Philadelphia, on September 17, 1924.

truth of dogma of any kind. Yet we have among us many who have blamed scientific developments for much of the terrible war we have so recently passed through, forgetting that a simple, short bar of that most useful of all metals, steel, can, by the simple act of sharpening one end thereof, be converted into a very dangerous weapon; but without the hand and mental resolve to wield it, how harmless! We will eliminate war, that horrible specter which menaces civilization, when we, through understanding, unite the souls of men in the conquest of nature by science, which holds out limitless possibilities in every direction and when we obliterate greed, dishonor and bitterness—even that of religious differences—from men's minds; and when we substitute for these evils candor and generous regard, with a passion for the real truth of things in our relations in life.

It is through the ideals and work of such organizations as the Franklin Institute that we may look for at least a part of this harmonizing process. Institutions of learning, and learned bodies in general, can legitimately have such ideals as a general object, though perhaps it may be necessary for some of them, a little hide-bound in ancient lore, to moult at least a portion of their long-worn integument and grow a new and more modern covering.

However all this may be, the ever-growing unity of science in all its departments, the interdependence of its advances and the mutual aid which one department can and must give to another, is of great significance for the future.

It has appeared to me that it would be well at this time briefly to review the origin of the institute one hundred years ago and its activities in the century past.

The Franklin Institute

In addressing this distinguished gathering on the subject of our Franklin Institute and the services it has rendered to scientific progress and public instruction during the past hundred years, I shall be unable to present more than a mere outline of the activities which it has sponsored; the researches which it has through so many years carried on or assisted; its influence upon education and the outgrowth thereof—its broad fostering of the mechanic and technical arts, including its drawing and architectural schools, its assistance to governmental work; its encouragement to invention and discovery, and to inventors themselves; its free library, of so great value for reference; its notable and successful exhibitions; its long established lecture courses, its valuable committee work; and the many other avenues of effort through which it has demonstrated its inestimable worth, not only to the immediate public in Philadelphia, but to the world at large.

When organized in 1824, chiefly through the effort and interest of Samuel Vaughn Merrick, assisted by Professor Wm. H. Keating, of the University of Pennsylvania, the main object of the institute was to combine the idea of the Mechanics Institute, a type of society of which many examples were then being formed, with that of a learned society, whose membership usually included only those who had been selected because of their possessing superior knowledge in the branches to which the society was devoted.

It was recognized, in those far off days, that there was a great fund of practical information in the possession of the skilled worker or mechanic, which ordinarily was unavailable to students in the arts and sciences; and that, on the other hand, it was desirable that the more advanced knowledge of the sciences should reach those engaged in practice of the arts. Thus, the professor, the layman, the master mechanic and the workman could be brought together to the mutual benefit of all. This idea, in a broad sense, has continued through the hundred years of the history of the institute, aptly named after Franklin, of whom great versatility and deep interest in scientific discovery and in the general knowledge of his time, as well as in the practice of the arts depending thereon, was so characteristic. We may recall that Franklin, the printer, the philosopher, the statesman, was a leading spirit in the founding, here in Philadelphia, of the American Philosophical Society, a learned body, the membership in which extends throughout this country and the world. That society celebrated its hundredth anniversary many years ago.

The charter of the Franklin Institute was granted by the legislature of the State of Pennsylvania, on March 23, 1824, with the title: "An Act to Incorporate the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts." Later the means whereby this promotion was to be attained were formally stated to be: First, by the delivery of lectures on the arts and the applications of science to them; second, by the formation of a library of books relating to science and the useful arts, and the opening of a reading room; third, by examinations of all new inventions and discoveries by a committee of learned and honorable men; fourth, by the publication of a journal to contain essays on science and art, specifications of English and American patents, etc.; fifth, by holding exhibitions of American manufacturers and awarding medals to worthy workmen; sixth, by building a hall for the meetings of the institute and the use of the members; seventh, by collecting machines, minerals, materials, etc., used in the mechanic arts; eighth, by the establishment of schools for the teaching of architecture and mechanical drawing, chemistry applied to the

arts and mechanics, and, if possible, of a high school for giving young men a liberal and practical education.

This was indeed an ambitious program, so comprehensive in its scope that little could be thought of as desirable to add to it. It was characteristic of the men to whom, as leaders, the institute owes its existence. It is related of Mr. S. V. Merrick that, as a young man of twenty-one, he found himself "owner of a workshop, without a mechanical education, and with scarcely a mechanical idea." To improve this condition, he applied for membership in a local mechanics institute and was *blackballed,* as lacking the qualifications for membership. He then apparently determined to found an organization after his own ideas.

I will not attempt to detail the steps in the formation of the society, as this is already part of the records and need not be repeated here. Suffice it to say that a well-attended meeting of citizens was called on February 5, 1824, and its proceedings were eminently successful. It was presided over by James Ronaldson, Esq., who was then the leading type founder in the United States, and who continued as president of the new institute until 1841, when Mr. Merrick, so prominent in the inception of the organization, succeeded him and held the office until 1854.

A few other names may be mentioned as among the first promoters of the new society. They are Mathias W. Baldwin, Peter A. Browne, Oram Colton, Thomas Fletcher, Robert E. Griffith, Wm. H. Kneass, David A. Mason, James Rush, George W. Smith, M. T. Wickham and Samuel R. Wood. Many of these men were prominent citizens of Philadelphia in the early years of the nineteenth century. Philadelphia has always been a great industrial center, with industries and arts covering the widest range from the most delicate instruments and machines to giant locomotives and ocean liners, a range so great that it has often been said that the city had industries that could supply every need of its people and most of their luxuries.

The hall of the institute, on Seventh Street, above Chestnut, is now 98 years old, and has been made to serve its purposes through the many years which have elapsed, but only by the most careful adaptation of means to ends. It has long since been outgrown, though its older members, like myself, will always cherish for it a sense of respect, due to the many and valuable activities of which it has been the scene.

It was in that hall that I first listened to science lectures for the public, in which work without at the time suspecting it I was soon to take part. Becoming a member of the institute fifty years ago (in June, 1874, in fact), I was asked to give a course of five lectures on electricity during the season of 1876–7, which I somehow had the courage to undertake, though I was then only twenty-three. I confess that it was quite an undertaking. There was incidentally, I was told, some shaking of older heads over the choice of one so young for such a serious task. I really think, looking back, that it was these very doubts that steeled me and filled me with a resolve to do my best to win success. With apparatus, much of which was new and most of which was constructed by myself, including a small arc light dynamo —then a rarity—I set out to show that electricities of any name, static, dynamic, voltaic, electro-magnetic, magneto-electric, thermo, animal or what not, were one and the same, not differing essentially in any respect. The text-books of the day really treated of several separate electricities as if they were distinct varieties almost unrelated, except under the general title of electricity. Not to discover any vacant seats at any of the five lectures was to me a great encouragement. For several years thereafter I was on the list of lecturers at the institute, until I became at last engrossed with electric developments and removed from Philadelphia to New England in 1880.

At the last of these lectures in 1877, in reversing a Ruhmkorff coil by sending a Leyden jar discharge through its fine wire secondary, thus making it a primary, the first clue to what afterward became the art of electric welding was obtained. It may have been the first time that such an experiment as reversing a Ruhmkorff was ever tried.

It was the practice from the start of the institute to lay stress on its educational objects, and to this end it established schools for teaching, under the control of its board of managers. Professor Keating, already mentioned, was appointed professor of chemistry; Professor Robert M. Patterson, of natural philosophy and mechanics, and William Strickland, of architecture. There were appointed also committees on instruction, on inventions, on premiums and exhibitions, on the library, on models and minerals, etc.

The committee on science and the arts, which has functioned so effectively for a long period in the past, is the outcome of these early committees, at least in so far as the examination of new inventions and machines, together with recommendations of awards of merit, medals, premiums and the like, are concerned.

The institute had from the start several types of membership, and this condition still exists, but in eligibility for membership, there has been no restriction. The membership has been open to men and women, without discrimination as to race, nationality or religion, all that was needed being good character

and friendly interest in the objects for which the society was organized. Election after proposal has been left to the board of managers, who were, with the other officers, elected by vote of the members in good standing.

It might at first be imagined that such democracy in the membership would not be desirable, and that the objects of the new society would have been better carried out if the membership had been more restricted. The instructional value of the society was, however, so great that its meeting rooms and lecture hall became, as it were, the city's scientific and technical rostrum for the discussion of new advances in those fields to which it had devoted itself. Always leaning toward the technical, it became a great force in the community, the activities of which were so largely given to arts and manufactures. This was and is Philadelphia. Some sixty years ago the secretary was made a salaried officer, charged with duties of a scientific nature combined with literary work. Even at its inception in 1824, the new society took steps to establish a school for the teaching of mechanical and architectural drawing, an experiment so successful from the start that the encouragement received led to the more ambitious project of providing a school in which should be taught "all the useful branches of English literature and the ancient and modern languages." Begun in 1826 the records for 1827 show that over three hundred students were enrolled. And now comes the significant thing. These Franklin Institute schools furnished a model leading to the extension of the public school system in a few years to include such a school, a people's college. In fact, it is said that the Boys' Central High School was itself patterned after the institute schools and that the high school of the institute was thereafter abandoned as unnecessary. The institute retained, however, its drawing school, which has been for many years an important part of its activities.

To me, the facts just presented are of unusual interest, as I was graduated from the Boys' Central High School in 1870, and taught in that school as assistant professor and full professor for ten years subsequently, while at the same time occupying lectureships in the Franklin Institute, serving on its board of managers and committees and taking part in its meetings and exhibitions.

It is proper to recall at this time that, although the institute was organized to devote special attention to the mechanic arts, it has at various times and in effectual ways assisted the efforts made to elevate standards of taste in the cultivation of the fine arts as applied to the industries. The School of Design for Women, founded by the institute in 1850, was conducted by its committee for several years, until it became self-supporting.

The institute also extended its friendly cooperation and shelter during infancy to the "Pennsylvania Museum and School of Industrial Art."

Mr. Frederick Fraley, well known to older Philadelphians, as one who filled with great honor many positions demanding talent and integrity, and to whose unselfish devotion as treasurer the success in considerable part of the Centennial Exhibition of 1876 was due, has recorded much of the early history of the institute.

> The general interest created by the existence and working of the institute caused more attention to be paid to technology and to science generally, and in the year 1837 [a panic year, by the way] gave rise to a movement for the establishment of a School of Arts. The institute headed this movement and applied to the Councils of the City for a grant of a large plot of ground in West Philadelphia as a site for the buildings of the proposed school.
>
> This was promptly and cheerfully granted and the legislature was appealed to by memorials from all parts of the state to endow the school by a liberal appropriation.

This project, we are told, failed of success, but was subsequently realized in the plans of the University of Pennsylvania.

That there was need of cultivation in design and in art work generally in the country was patent enough. I think this was particularly true in machine design. It was the period when steam engines, lathes, planers and the like were built on architectural designs, including moulded cornices, fluted pillars and such like ornamentation. Locomotives were painted in all the bright colors, scarlet, chrome yellow, grass-green, etc., as agricultural machinery was later and some of it is to-day.

Besides its educational influence and activities, a most important undertaking of the institute was the establishment of its library, which in time became of a distinctive character in our country as a scientific reference library, exceptional in its accessibility and completeness. It contains to-day a great collection of the publications of principal scientific and technical bodies here and abroad, as well as the leading periodicals dealing with science and the useful arts. It also became in 1887 a public depository for the congressional district in which it is located. In this way, it was the custodian of valuable pamphlets and books which rendered much assistance later in the completion of sets of the publications of the various scientific and technical bureaus of the government.

As a patent reference library, including United States and foreign patents, the institute library has been most valuable to inventors and to others desirous of finding readily the status of ideas or inventions or to those wishing to obtain a review of an art with the

object of its improvement. So valuable a library as that of the institute badly needs space for its growth, overcrowded as it long has been. Ample protection from fire is indeed a necessity, long ago recognized as most desirable.

As a member of the institute I was fifty years ago a frequent visitor to this library, which was of great value in my early studies in the sciences and their applications. Its very atmosphere and the method of its conduct were alike stimuli to one in search of knowledge. This was many years ago, but I have no reason to believe that any of this has changed in the lapse of time during which its collections have been much enriched.

I can not leave this subject of the library without expressing the hope that it may soon be securely housed in the new institute buildings long contemplated, and that ample measures may then be taken to facilitate the use of so valuable a collection of the literature of science and technology.

Not in small measure, indeed, has the institute itself contributed to this fund of the literature of science. It has, in the publication of the *Journal of the Franklin Institute,* extended its usefulness far beyond the confines of the city and state which is its home. Appearing originally in 1826, under the title, *The Franklin Journal and Mechanics Magazine,* it was published under the patronage of the institute, and its editor was Dr. Thomas P. Jones, professor of mechanics in the institute. With the January issue of 1828, however, it was renamed *The Journal of the Franklin Institute,* which name has been retained.

In this journal it was originally intended to publish a list of patented inventions with remarks on their utility and originality. In fact, this idea was definitely carried out and remained an especially prominent feature of the journal up to the close of 1859, though the remarks on utility and originality were discontinued in 1848 when Dr. Jones, who had continued as editor from the start, died. He had in the meantime been made superintendent of the U. S. Patent Office, which fact doubtless led him to call attention to the records of patents by making them a part of the text of the journal itself.

It happens that in the publications of the Government Patent Office, prior to 1843, there was no printed account of the claims of the patents as issued, and these were listed only in the institute journal, which for the period 1826 to 1859 gave the claims as well as abstracts of the specifications of the patents issued by the United States. Thus, the journal became and remained the only source available at any time for a record of the claims of patents issued between 1828 and 1842, inclusive.

This circumstance throws a curious sidelight on the comparative crudity and incompleteness of the patent system in the United States even eighty years ago, and within the early years of the formation of the institute. It is probable that we have now in the United States a patent system which has no superior anywhere. To its liberal patent system, with its encouragement of invention, we may perhaps trace in major part the reputation for inventiveness acquired by our people. To such a system, facility in determining what is new and what is old is second cousin. The library of the Franklin Institute, replete as always with patent publications, has provided just such facility. It has also provided for the earnest student access to scientific and technical journals and other publications, in a measure not easy to overestimate.

All this valuable work has been done with a relatively small endowment and with a similarly limited library force. It is a free public reference library, containing an exceptional collection of books, pamphlets, journals, maps, charts, photographs, etc., bearing on science and its applications.

I think that it can be said truly that the journal of the institute has steadily improved with the flight of years, so that the papers published therein, largely based on the lectures and discourses at the institute itself, have reflected the general advance in science in its latest and most recondite aspects. It has achieved a most enviable reputation, both here and abroad, for the standing and general excellence of the material which appears in its pages.

This necessarily brief account of the objects and services of the Franklin Institute would be very imperfect if some allusion were not made to its function of investigation, examination and award accomplished through its committees during the century of its life.

Early in its history, a special committee of the institute made a careful investigation of water-wheel efficiency, examining the various types then known, and the results appeared in the journal. This was followed by a committee investigation of the cause of steam boiler explosions, not very uncommon in those early days. In this investigation, the committee secured the cooperation of the government, with an appropriation therefrom to defray the cost of the experiments, without, however, allowing any compensation to the members conducting them. It was volunteer work through many months and resulted in great public benefit. Allied to these boiler tests was an examination of the strength of materials used in construction, the results of which were also published fully in the journal.

A notable page in the history of the institute's activity and service is the interest elicited in the study of meteorology by lectures and essays of Professor Jas. P. Espy, leading to the appropriation by the

state of $4,000 in 1843 for the acquisition of instruments and the establishment of observing stations throughout the state of Pennsylvania. The committee on meteorology of the institute, in conjunction with a like committee of the American Philosophical Society, conducted the observations for the study of weather conditions and storms.

This early meteorological work gave rise to a theory of storms which foreshadowed in large measure the views subsequently adopted. It was a work carried on before the days of telegraphy, and was later followed by the establishment of weather bureaus in this and other countries. There is no need to speak of their value in agriculture and in commercial enterprises. In 1887, following the lead of the Franklin Institute, there was begun the Pennsylvania State Weather Service, which has been so successful in more recent years.

To mechanical engineers and machine manufacturers, the results of the work of the special committee for studying the shapes and proportions of screw threads are well known. As far back as 1865, its report was adopted by the institute. It proposed for adoption a simplified system of screw threads which shortly thereafter was adopted by the government and called "The United States or Franklin Institute Standard Thread." This system was adopted throughout the country. The records show that the same system, modified only in dimensions to suit the metric system, was reported favorably by the Associated Engineering Societies of Germany in 1887.

In 1875, an expert body nominated by the institute cooperated with the Philadelphia Water Department in considering the then present and the future water supply of the city, making an elaborate report, published in abstract in the journal at that time.

Reference should also be made to the investigation of the 1877–78 committee on dynamo electric machines, then rare; machines used in operating single arc lights. It was probably the earliest inquiry of the kind, and served to bring out much important data, as well as to reveal certain facts, before unknown, concerning the electric arc itself, and the relation of internal and external resistance of the circuits, voltage, etc., to efficiency in the utilization of driving power.

It was demonstrated for the first time that the greater the external or work resistance was, in relation to the internal resistance, of a dynamo, the higher was the efficiency, other things being equal. I had some years before this been constructing small dynamos and studying them. They were indeed rare machines in those days. Serving as I did on the committee as one of those in charge of electrical determinations, the work was to me most inspiring and valuable as a foundation for my future efforts in the field. The work of the committee preceded the appearance of the carbon filament lamp of Edison by nearly two years. The report of the committee is to be found in the May and June numbers of the journal of 1878.

About six years afterward, at the time of the institute's international electrical exhibition in the fall of 1884, the first electrical exhibition held in America, this earlier work in the electrical field was supplemented by more elaborate reports of similar scope, but the great growth of the electric lighting industry, which had taken place in the intervening years, furnished an abundance of material which only emphasized the paucity of that to which the early work was restricted. A notable feature of the work at the exhibition of 1884 was the report on the "Life, duration and efficiency of incandescent lamps."

The institute published in its journal of December, 1881, a report on "The conditions of safety in electric lighting." It is probably true that it was a first exposition of a number of conditions to be followed in the wiring of buildings and in the installation of circuits, afterward incorporated in underwriters' rules.

In the foregoing brief outlines of the long past work of some of its committees, an account which could, if there were need, be greatly extended, no mention has been made of the practically perpetual committee on science and the arts. Continued in one or another form from the very start of the institute, this committee has, up to the present, been an important factor in carrying out the original objects of the founders in 1824. At first it was a standing committee of five members, called a Board of Examiners, the duty of which was to examine and report on new and useful machines, inventions and discoveries which were submitted to them. Later the name was changed to the "Committee on Inventions." Continuing in this form and enlisting the voluntary services of members notable for their attainments in mechanics until 1834, it was then replaced by the "Committee on Science and the Arts," and at the same time its scope was enlarged. The records disclose a rather ambitious set of functions, continued for more than fifty years, the journal being much enriched by the labors of the body. This committee had been, prior to 1886, a voluntary association of members, but was reformed in that year on the elective basis, consisting of forty-five members, fifteen being elected each year. The condition of their choice was that they "shall pledge themselves to perform such duties as may devolve upon them, and to sustain by their labors the scientific character of the institute."

An important duty of the committee, calling for care and discretion, is in the awards of medals, certificates of merit and diplomas. The Elliot Cresson gold medal, named after its founder, is awarded as a

mark of recognition for inventions and discoveries of unusual or permanent value. The committee is empowered to award the "Medal of Merit" (made possible by the bequest of Edward Longstreth, at one time vice-president of the institute), also the "Certificate of Merit" and the "Diploma," according to its judgment. The "John Scott Legacy Medal and Premium" is awarded by the city of Philadelphia on the recommendation of the Committee on Science and the Arts, the action of the committee having been followed in making this award by the Board of City Trusts. It was established by John Scott, of Edinburgh, Scotland, as a recompense to ingenious men and women who make useful inventions.

This medal is not now awarded as formerly on the recommendation of the committee. Ten years ago there was established the Franklin Medal by Samuel Insull, president of the Commonwealth Edison Company, of Chicago, and the award of this medal is now esteemed the highest honor which the institute has in its power to bestow. The first Franklin Medal was awarded to Thomas A. Edison in 1915—and a later award has been made to Heike Kamerlingh Onnes, the great leader in low temperature research.

The fact that throughout a century such work has been carried on by this committee with so satisfactory results and with unwavering honesty of purpose is in itself a testimonial to the fidelity with which it has performed the tasks set for it, while the services of its members have at all times been rendered without compensation. It is most unlikely that such a record can be matched anywhere. All the members of the committee have been chosen by the institute as far as possible because of expert ability in professions or trades, eminent in their attainments and reputation. This prestige has been of the greatest value to the standing of the institute at large before the public.

In the early conception of the organization of our institute, the holding of exhibitions for showing to the public the products of industries and the advance in the mechanic arts and in technical science was made an important aim. It was thought that thereby encouragement might be given, and healthy rivalry among the exhibitors stimulated, which would result in lasting benefit to them and to the public. This was at a period when American manufacturers were in their infancy and needed encouragement to enable them to compete effectually with foreign productions. The early exhibitions appear to have been successful, and the records of them disclose interesting facts concerning the inception and growth of manufacturing in the United States. Premiums were awarded for meritorious accomplishment. To this end and to gain the confidence of the exhibitors, skilled examiners or judges were chosen for weighing the merits of the exhibits themselves. There can be no question that the conduct of these exhibitions served to increase the influence of the institute very greatly, and to inspire confidence in the public mind, as well as to stimulate a sense of loyalty and pride in the members.

These exhibitions were held either yearly or biennially up to the year 1858, and in various places available at the time. Naturally the reports and awards of premiums and medals were much prized by the recipients, while the exhibitions themselves served to nurture and encourage young and growing industries and to improve those already firmly established. In the records of the exhibitions the historian finds a rich mine of information in the accumulation of data thus brought together concerning the origin and progress of the industrial arts.

The two most notable exhibitions held by the institute were those of 1874 and 1884, the former commemorating the fiftieth anniversary of the founding of the society, and that of 1884 being distinctive in that it was the first international electrical exhibition held in America. It may be said to have commemorated the establishment of the early electric industries soon after to become of the greatest importance, not only to progress in the arts themselves, but in the development of our social system. As I have pointed out before, the great structures such as the tall and multifariously cellular buildings called skyscrapers, characteristic particularly of New York City, could not exist without three electric agencies: the electric light (gas would have made furnaces of them), the telephone, the absence of which would have been fatal in itself, and the electric elevator, a high speed vertical railway for quick passenger traffic between floors from top to street and even below street level.

I remember well the 1874 exhibition, held in the Old Pennsylvania Railroad Station at 13th and Market Streets, where the Wanamaker stores, well known to every Philadelphian, were erected soon after. It was in every sense a well-planned industrial exhibition, worthy of the institute, and served much to increase the prestige of the society. I had myself been elected to membership in June of 1874, and my first duty as a member was to serve on a committee of judges of exhibits in the field of scientific apparatus, chiefly optical and electrical. It was my first experience of the kind, and being but twenty-one years old at the time, the sense of responsibility engendered is a lasting remembrance.

It was at this exhibition that the Tilghman sand blast process, which in later years became of signal importance in several arts, was shown as a novel development. I can not remember that a single dynamo generator of electricity formed part of this exhibition, excellent as the showing was in many

departments of manufacture, machinery and the inventions of the time. Yet, in less than ten years from 1874, there had come into existence systems of arc and incandescent electric lighting, destined to revolutionize the whole art of illumination.

At the Centennial Exhibition of 1876, there were, as I remember, only two types of dynamos displayed, the Gramme and Wallace-Farmer, the latter of which soon disappeared after the Franklin Institute Committee's tests of 1877–8 had shown its very low efficiency as compared with the Gramme dynamo, and after the causes of that inefficiency had been pointed out by the committee. In less than two years, or in 1879, there appeared the series arc lighting systems of Brush, of Cleveland, the Thomson-Houston series system, with its automatic regulation, in Philadelphia, the Weston system in Newark, N. J., and others, and these several systems were in use that year in a number of places for the lighting of spaces to which the arc lamp was best adapted. The principles of dynamo construction and operation began to be fairly well understood by those who were connected with their design.

At the very close of 1879, Edison announced the incandescent lamp with its carbon filament, sealed bulb and high vacuum, and made the first showing of a few such lamps at Menlo Park, N. J. Central stations for arc lamp distribution in cities were beginning to be established, and a year or two later, the Pearl Street Station, the first for the distribution of incandescents on the Edison plan, was established in New York. This was followed a year later by the improvement known as three wire distribution, which was first installed in a lighting station in the city of Brockton, Mass., in 1883. This brings us close to the important institute exhibition, entirely electrical in character and international in scope, which was opened in the fall of 1884. This exhibition was not only an excellent display of the latest developments in the larger electrical applications, but it served to bring together the scientific men here and abroad in a notable congress, their meetings and discussions adding greatly to the knowledge of the principles of the new industry. My own first meeting with Sir William Thomson, afterward Lord Kelvin, the centenary of whose birth was celebrated in London in July last, occurred at these meetings in 1884. Along with Sir William Thomson were scientific men of international reputation such as Lord Rayleigh, Professor Silvanus P. Thompson, Wm. H. Preece, Professor Geo. Forbes, Professor W. A. Ayrton, and others. Professor Forbes I had the pleasure of meeting in London lately, and he is the only survivor of these named. Of our own country, there may be mentioned such names as Professor Henry A. Rowland, Professor Geo. F. Barker, Simon Newcomb, Professor C. F. Brackett, of Princeton, Professor F. Willard Gibbs, Professor John Trowbridge, Professor Charles A. Young, and others of high standing in science at that time. None of these now survive.

The several international electrical congresses, which have generally been held in connection with the larger international exhibitions, have had for their principal end the establishment of uniform definitions, designations and values for the fundamental units, such as the ohm, the volt, the ampere, the henry, etc., and it is owing to these bodies that not only the names, but the values and methods of determining such values have become uniform throughout the world. At the International Electrical Exhibition of 1884, there was organized an Electrical Congress, the first of its kind in America, followed later by the important gathering of international delegates at the World's Fair in Chicago, in 1893, and still later by the Chamber of Official Delegates at St. Louis, in 1904. Following this international gathering, there was established the International Electrotechnical Commission, the work of which has continued uninterruptedly to the present time.

The educational value of the exhibitions has unquestionably been very great, yet such has been the advance in technology since the beginning of the present century and before, that an exhibition, even restricted in its scope, would at once become too vast and beyond the power of such a body as the institute properly to finance and organize. Hence, exhibitions of the character of those of 1874 and 1884, to be at all adequate in representation, must necessarily, it seems, be held in the future, if at all, under the auspices of governments which also furnish the financial support as in constructing suitable buildings, in installing exhibits and in providing for the many activities which are necessarily involved. The British Empire Exhibition, held in London this year, is an example of the type which must survive in the future.

These facts can not, however, dim the fame of the institute resulting from the successful conduct of the exhibitions which have characterized its past. Abundantly useful as the institute has been in the past century in furthering scientific knowledge, particularly as applied to the arts, and numerous as have been the instances of brilliant work accomplished, can we doubt that, under proper guidance and with the firm policies which have become characteristic of it, the future holds equal promise of accomplishment? It is for the public to realize the true value of the possible services it can render and accord to it proper support. Endowments such as the Bartol Research Foundation are needed, and will be more needed in

the future than in the past. The ramifications of applied science naturally increase, and the delicacy and cost of research grows, the deeper we penetrate nature's secrets. There must be an increasing corps of workers, with the increasing extent and variety of the problems presented for solution. It is to be hoped that the institute may receive generous support in the coming years, and that its usefulness in carrying out the original objects for which it was founded may not be restricted by inadequate means of provision. Those among us who are of the older generation can hardly hope to see much of its future growth, but the heritage which the younger generation has received from the past should be the stimulus to continue and increase the good work which so far has characterized the work of the institute in its various forms. While the associations which have grown up around the old hall on Seventh Street stir many emotions in many of the older members, yet it is to be assumed that not many more years will elapse before the proposed new hall and library on the new site may become a reality.

Elihu Thomson

General Electric Company,
Lynn, Massachusetts

QUETELET'S SCIENTIFIC WORK

Fifty years have passed since the death of one of the most remarkable men to whom Belgium has given birth, Quetelet. It is very much to be regretted that this important anniversary should have been forgotten officially. Yet we have here a fine and universally appreciated scientific reputation. Besides, it would have been an opportunity to recall the example of a life entirely devoted to science and animated by a glowing and strengthening enthusiasm.

At seventeen Quetelet took up teaching at a private college of Audenarde, a small town in Flanders. Six years after that, he took the degree of doctor of science at the University of Ghent, with a remarkable dissertation in the field of geometry. The following year he was received as a member of the Royal Academy. From 1823 on, he suggested that the secretary of public instruction should create an observatory in the southern provinces, Belgium forming at that time part of the Netherlands. This happy project was realized a few years later after much patience, perseverance and energetic effort. Quetelet, having been appointed head of the new institution, organized completely its scientific function. The attention and the appreciation of the learned world had been especially attracted to him by his statistical work. His first paper on demography: "Sur les lois des naissances et de la mortalité â Bruxelles" ("On the laws of birth and mortality in Brussels") was published in 1825. Ten years later his fundamental work: "Essai de physique sociale (sur l'homme et le développement de ses facultés)" ("Essay on social physics, concerning man and the development of his faculties") saw the light in Paris. It is a synthesis of Quetelet's statistical works. In that book, the author studies the average man, in his physical and moral aspects. This audacious theory was taken up again and completed in another work: "Du système social et des lois qui le régissent," ("Of the social system and the laws that govern it," 1848). In 1841, Quetelet was called to direct the activities of the Central Commission for statistics, of which body he soon made a highly famous institution. The last years of his life were devoted to an active and fruitful participation in the work of the international meetings for statistics, and to several works of a general character, namely to the preparation of a second edition of his "Social Physics" (1869). He died on the 17th of February, 1874.

Without being transcendental, Quetelet's mathematical work is interesting and original. His researches concerning the theory of caustics have opened the way for important work. Thanks to him the first Belgian periodical devoted to exact science was created, *La correspondance mathématique et physique* (1825). Finally, he is the author of a documentary work that is worthy of notice: "Histoire des sciences physiques et mathématiques chez les Belges" ("History of Physical and Mathematical Science in Belgium," 1864). Quetelet's activities in the field of astronomy have consisted in a particularly rich work along various lines, such as descriptive astronomy, magnetism, meteorology and terrestrial physics. It is necessary to mention especially his great work on the climate of Belgium. But his universal reputation rests, without doubt, on his statistical work. His name is closely linked to the history and the development of the science of statistics. His numerous papers on demography and his remarkable analytical and synthetical studies of statistics are important in many respects.

Quetelet was a master of statistical method. He also was its apostle. The work he accomplished in statistics is extensive and fundamental. Therein lies his real scientific merit. In a general way Quetelet's statistical doctrine can be thus characterized: to a monographical description of facts, to a systematical census of elements, he substitutes a scientific observation of the masses, a methodical survey of the groups, founded on the principles of the theory of probabilities. Thence one easily admits the fundamental idea that rules all Quetelet's statistical investigations: the statistical method is the application of the calculus of probabilities to the observation of facts. Sixty years ago this was an audacious and original doctrine. It

seems that Quetelet was right. The paper of 1845 "Sur l'appréciation des documents statistiques et la théorie des moyennes" ("On the valuation of statistical documents and the averages"), was a first step in the science called biometry to-day. On the other hand, the actual prodigious rise and the important developments of mathematical statistics justify Quetelet's idea of considering the statistical method the function of the calculus of probabilities.

For Quetelet, statistics are a science. If this is so, it is not sufficient to collect documents and numbers, taking care only to group them so as to make comparisons more easy. That is administrative statistics. There is also the more important scientific side which valuates the documents and the results, and draws conclusions from them. That is scientific, or better, mathematical statistics, to which all administrative statistics must aim. A hundred years ago, Fourier said: "Statistical researches will make no real progress until they are performed by those who have thoroughly investigated mathematical theories."

It has been rightly said that Quetelet's average man died before his author. The average man, far from being, in a way, the type of the species, is simply impossible. Cournot and Bertillon have given a justified and definite criticism of this theory of the "type." As to the average moral man, he is a pure mathematical fiction. To-day that theory is quite forgotten.

Quetelet was a great Belgian. Endowed with a superior mind, a high and clear intelligence, being a real scientist, a persevering investigator, he has given a vital impulse to the study of science in Belgium. His work is complex; it abounds in valuable and deep teachings. Quetelet was a real statistician. For more than a quarter of a century he has been an important figure in the intellectual life of Belgium. He has truly given momentum to Belgian thought.

CONSTANT LURGUIN
UNIVERSITY OF BRUSSELS

SCIENTIFIC EVENTS

NEW MEDICAL CENTER IN NEW YORK CITY

A NEW medical center, which is to cost approximately $20,000,000 and is to embody the latest developments in cooperation between hospitals, medical colleges and research institutions, is assured for New York City with the announcement by the Board of Managers of the Presbyterian Hospital of its decision to erect a building jointly with the College of Physicians and Surgeons of Columbia University at Broadway and 168th Street.

According to the New York *Times*, the structure, which will be the center of a group of buildings, will cost $10,000,000, exclusive of the land. That section to be occupied by the College of Physicians and Surgeons will cost $3,000,000. This amount has already been subscribed. The Presbyterian Hospital section will cost $7,000,000, of which $2,500,000 is available, leaving $4,500,000 still to be raised.

When the medical center is completed there will be available in one place the services of leading specialists in every branch of medicine. It is said that the institution will surpass Berlin, Vienna or any other center in Europe. This will be the first complete adaptation of the medical center idea to the needs of New York City. It is planned to include, in a well-coordinated form, every type of special hospital and institution necessary for the treatment of any patient and the training of any specialist who has to do with the protection and promotion of health.

The tentative plan was first announced three years ago. Since that time careful study of the medical centers now in operation at Johns Hopkins, Harvard, Yale and other institutions has been made by the joint administrative board.

In addition to facilities for the care of patients, the new building will provide a place for scientists to collaborate in research work, and will have the equipment for training practitioners. Thus the center will embody three branches—care, research and teaching. It also will contain a nucleus for a medical group of wider scope, and it is expected that around it will be drawn such institutions as a dental school, a maternity hospital, a children's hospital and a neurological institute.

The hospital section of the building will be directly connected with the medical college. Faculty members, who will also be on the staff of the hospital, and students observing, will thus no longer lose the time they now must spend in going between classrooms, hospitals and laboratories scattered in various parts of the city.

The private pavilion, with 125 rooms, will also be attached to the building, and the income from these rooms will be devoted to meet the cost of free work in the wards. One of the features will be private rooms to be rented to relatives and friends who wish to stay near patients.

Within a short time the Presbyterian Hospital will launch a campaign—the first public appeal it has ever made—for gifts in order to raise the $4,500,000 necessary to complete the building fund. Members of the building fund committee are Thatcher M. Brown, Cornelius R. Agnew, the Rev. Dr. George Alexander, Robert W. Carle, Henry W. de Forest, W. E. S. Griswold, Dean Sage, Johnston de Forest, Samuel H. Fisher and William Sloane Coffin.

NATIONAL CONFERENCE ON THE UTILIZATION OF FOREST PRODUCTS

SECRETARY WALLACE, of the Department of Agriculture, has issued a call for a national conference on the utilization of forest products, to take place in Washington on November 19 and 20, which will mark the first comprehensive attempt to consider the economic use of existing timber supplies in the forestry conservation program.

Premises on which conference is called

1. We are faced with the momentous problem of perpetuating a supply of forest products sufficient to meet the needs of the greatest wood-using nation in the world.

2. Our national forest policy and plans for reforestation, now in the formative stage, must be shaped so as to meet the basic requirements of use; at the same time, wood usage must be greatly modified to conform to the present under-supply, and eventually to the accomplishments possible through reforestation and protection.

3. Diminished forest resources will, within the next generation, have a radical effect on wood using practices, manufacturing enterprises and living conditions in this country. It is imperative that the existing supply be conserved and apportioned as effectively as possible.

4. Approximately two thirds of the present forest cut is lost in the processes of conversion and through inefficient use. Approximately one third of the loss is now preventable if available knowledge can be generally applied; one third is not now preventable, but continued research can probably determine how prevention may be accomplished; one third will probably remain permanently unpreventable.

5. Effective accomplishment in better utilization demands the joint efforts of federal, state and private interests in the development and execution of adequate plans for the following three types of activities: (1) application of research findings, (2) direction and coordination of economic tendencies, (3) further research.

Purpose of Conference

1. To obtain national recognition of the foregoing premises, and of the fact that better utilization of forest products ranks with forest protection and timber growing as one of three essential elements of an effective forestry program.

2. To establish a nationally representative advisory committee to assist the Secretary of Agriculture in formulating and carrying out adequate measures to insure the most efficient development and use of our forest resources.

Program of the Conference

The speakers and subjects will be selected with the following objects in view:

1. To present a comprehensive idea of the nature and extent of the present preventable wastes, how the findings of research show prevention to be feasible, and how better utilization is retarded not only by economic conditions, but by failure to apply available knowledge.

2. To present a comprehensive idea of the nature and extent of the present unpreventable wastes, and how an enlarged program of research will develop means of prevention.

3. To promote discussions of policies and measures which might be supported and executed by industrial, professional and governmental agencies, both singly and jointly, to insure the most efficient development and use of our forest resources.

4. To expedite action by the conference in creating a permanent advisory committee on utilization of forest products.

Representatives at Conference

The Secretary of Agriculture has asked all associations and organized interests concerned to select delegates to represent them at the conference. It is his desire that the conference be truly representative, and all interested are cordially urged to attend.

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE forty-fifth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York City, from December 1 to 4. For the third consecutive year the meeting will be held coincident with the Power Show.

The technical program includes joint sessions of the machine shop practice division of the society with the special research committee on cutting and forming of metals, the special research committee on lubrication and the management division, respectively; a session on oil burning sponsored by the power and fuels divisions and a session on the handling and storing of oil sponsored by the materials handling division.

A paper on the Zoelly Turbo-locomotive, by Dr. Henry Zoelly, of Switzerland, and a paper on the petroleum situation in the United States by Dr. Julian D. Sears, administrative geologist of the United States Geological Survey, will be included in the program.

New officers for 1925 have been elected as follows:

President, Dr. William F. Durand, Stanford University, Calif.

Vice-presidents, Professor Robert Angus, Toronto, Canada; S. F. Jeter, Hartford, Conn.; Thomas L. Wilkinson, Davenport, Iowa.

Managers, John H. Lawrence, New York City; Edward

A. Muller, Cincinnati, Ohio; Paul Wright, Birmingham, Ala.

Treasurer, William H. Wiley, New York City.

Delegates to American Engineering Council, Dr. William F. Durand, Stanford University, Calif.; Fred R. Low, New York City; Wilson P. Hunt, Moline, Ill.; I. E. Moultrop, Boston, Mass.; E. N. Trump, Syracuse, N. Y.; William W. Vareny, Baltimore, Md.; Ira Dye, Seattle, Wash.; W. S. Finlay, Jr., New York City; Dean E. Foster, Tulsa, Okla.

AMERICAN ASSOCIATION OF MUSEUMS

The American Association of Museums has removed its headquarters from the Smithsonian Institution, Washington, to New York City. The new offices are on the 10th floor of the office building, at 2 West 46th Street, New York City. This change has been prompted by a belief that more effective service can be rendered to museums under the new arrangements.

The association is entering upon the second year of a three year period during which the financing of an enlarged program is assured. Continuance of the work beyond the limits of this trial period will hinge entirely upon the effectiveness of performance now. Inasmuch as experience of the past year has pointed to New York as the most convenient center of association activities, it has seemed imperative to establish headquarters there.

Since May 1923, the association has received the hospitality of the Smithsonian Institution, which has furnished it with office space in the old National Museum building. In leaving Washington, the officers of the association express their gratitude to the Smithsonian Institution and their feeling of reluctance in losing a part of its cooperation.

Laurence Vail Coleman,
Secretary

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

The Board of National Research Fellowships in the biological sciences held its fall meeting on September 6 and made the following appointments:

B. E. Gilbert, botany.
T. N. Jenkins, psychology.
W. E. Loomis, botany.
Helen Redfield, zoology.
A. M. Showalter, botany.

The next scheduled meeting of the board will come in April, 1925. Applications for consideration at that time should be in the hands of the board (office: National Research Council, Washington, D. C.) not later than the first week in March, but may be received at any time during the year prior to then.

Frank R. Lillie, *Chairman*
Board of Fellowships in the Biological Sciences
National Research Council

SCIENTIFIC NOTES AND NEWS

Harvey Society lectures, under the patronage of the New York Academy of Medicine, for the season 1924–25, will be given as follows: October 25, Dr. W. S. Miller, professor of anatomy at the University of Wisconsin; November 15, Dr. A. V. Hill, professor of physiology at University College, London; December 6, Dr. W. Einthoven, professor of physiology at the University of Leyden; January 17, Dr. A. R. Dochez, associate professor of medicine at the College of Physicians and Surgeons, New York; Professor O. M. Schloss, professor of pediatrics at Cornell University Medical College. There will also be a lecture by Professor T. Madsen, director of the State Serum Institute at Copenhagen. Titles of the lectures will be announced later.

Dr. Archibald Vivian Hill, professor of physiology at the University College, London, will give the sixteenth course of lectures on the Herter Foundation of the Johns Hopkins University School of Medicine, as follows: October 16, "The dynamics of muscular activity;" October 17, "The heat-production of muscle;" October 20, "The chemical changes accompanying muscular activity;" October 21, "The recovery process after exercise in man."

The faculty of medicine of Harvard University has announced two lectures, to be given under the Edward K. Dunham lectureship for the promotion of the medical sciences on October 21 and 22, by Willem Einthoven, professor of physiology at the University of Leyden, on "The relation of the mechanical and electrical phenomena of muscular contraction with special reference to cardiac muscle."

Dr. Edward Hart, dean of the Pardee scientific department of Lafayette College, has been given the title of professor of chemistry emeritus. Dr. Hart's connection for fifty years with the Lafayette College faculty is now being celebrated.

Dr. Harvey Cushing, professor of surgery at the Harvard Medical School, has been elected a member of the Medical and Surgical Society of Bologne.

Dr. Douglas W. Johnson, professor of physiography at Columbia University, who represented seven American universities as exchange professor in applied science and engineering to the universities of France for the academic year 1923–24, has had conferred upon him by the French government the decoration of Chevalier of the Legion of Honor.

THE American Geographical Society of New York has presented the Serbian physical scientist, Dr. Yovan Tsviyitch, professor at the University of Belgrade and president of the Serbian Academy of Science, with a gold medal, in token of recognition of his services in the field of geography.

THE Royal College of Physicians of London has bestowed on Dr. Albert Calmette, assistant director of the Pasteur Institute, the gold medal and the Weber-Parkes triennial prize for the best original article on tuberculosis.

CAPTAIN EDWARD KIDSON, formerly of the department of terrestrial magnetism of the Carnegie Institution, now with the Commonwealth Meteorological Bureau at Melbourne, Australia, has received the honorary degree of D.Sc. from the University of New Zealand.

DR. M. JEAN CAMUS, professor of physiology at the Paris Medical School, has been elected a member of the French Academy of Medicine.

THE French Academy has awarded one of the Montyon prizes to Dr. Rodiet, chief of the Ville-Evrard Asylum, for his manuscript "Reminiscences of an army medical officer during the world war."

PROFESSOR H. PITTIER, connected for twenty years with the U. S. Department of Agriculture and now director of the Commercial Museum at Caracas, Venezuela, recently received from the French government the ribbon of Officier de l'Instruction publique, in recognition of his work on the botany, geography and ethnology of Central and South America.

DR. W. J. V. OSTERHOUT, professor of botany at Harvard University, has been appointed a member on the scientific staff of the Rockefeller Institute for Medical Research. He will assume his new duties on September 1, 1925.

DR. C. S. PALMER has accepted a position with the bureau of scientific research of the Institute of American Meat Packers, of which Dr. W. Lee Lewis is director. For the present, Dr. Palmer will conduct the experimental part of his work at Northwestern University.

DR. FRED W. WARD has recently accepted the position of chemist-pharmacologist in the Federal Department of Health, at Ottawa, Canada.

F. P. GROSS, formerly on the staff of the department of chemistry at Cornell University, is now connected with the Air Reduction Sales Company.

AFTER seventeen years of service, Dr. W. C. Geer, vice-president in charge of research at the B. F. Goodrich Rubber Company, Akron, Ohio, has resigned.

R. J. BLAIR, who has had charge of the work in pathology at the Forest Products Laboratories of Canada since this line of work was established in 1915, has resigned from this position in order to engage in farming at Ormstown, Quebec.

DR. CRICHTON MITCHELL, superintendent of the Observatory at Eskdalemuir of the English Meteorological Office, retired on September 1.

DR. WILHELM V. BRANCA, formerly professor of geology and paleontology at the University of Berlin, celebrated his eightieth birthday on September 9.

DR. N. H. DARTON, of the United States Geological Survey, has returned to Washington after an extended examination of the ruins of the archaic temple of Cuicuilco, twelve miles south of the city of Mexico, for the purpose of determining their age and relation to the surrounding lava flow. The investigation was made for the National Geographical Society, which is cooperating with the Mexican government in unearthing the ruins.

NEIL M. JUDD, curator of American archeology in the U. S. National Museum, who left Washington early in May to resume direction of the National Geographic Society's explorations at prehistoric Pueblo Bonito, New Mexico, has recently returned from the west. The past season, the fourth at Pueblo Bonito, proved noteworthy both as to the archeologic data collected and the amount of cultural material recovered.

DR. ALICE HAMILTON, of the Harvard Medical School, left on October 8 for Poland and Russia to study health conditions in industry there in behalf of the League of Nations, of whose health commission she is a member.

DR. J. ENRIQUE ZANETTI, associate professor of chemistry at Columbia University, has returned from abroad, where he went as a member of a special commission of chemical experts appointed by the League of Nations to examine into the present status of gas as a weapon of warfare.

DR. MORTIMER D. LEONARD, formerly associated with the United States Department of Agriculture, has returned after three months in Spain, where he studied methods of combatting the fruit fly.

A FRENCH Arctic expedition, headed by M. Jules de Payer, is to start for the polar regions at the end of next March, according to *Le Journal*. The party will proceed in a specially equipped vessel to the Franz Josef Archipelago, whence an attempt will be made to fly across the North Pole.

CAPTAIN ROBERT A. BARTLETT, the explorer, has announced plans to drift through the pack ice of

the North Pole, from Bering to Spitzbergen, 2,700 miles, in a small steamer. It is estimated it would require from three to five years to make the voyage.

DR. HANS ZINSSER, professor of bacteriology and immunology at the Harvard Medical School, delivered the address on the occasion of the seventy-eighth anniversary of Ether Day at the Massachusetts General Hospital, on October 16.

PROFESSOR S. P. L. SÖRENSEN, director of the Carlsberg Laboratory, Copenhagen, Denmark, delivered an address on October 7 before a joint meeting of the Washington Academy of Sciences and the Chemical Society of Washington, and on October 9 he lectured under the auspices of the Herter lecture fund at the Johns Hopkins University.

PROFESSOR V. BJERKNES, of the University of Bergen (Norway), will give a course of lectures at the California Institute of Technology this fall and then participate in a course of lectures and exhibit in Washington about the middle of December, at the Carnegie Institution of Washington, of which he is a research associate.

A BUST of the celebrated sixteenth century physiologist, Santorio Santorio, was recently unveiled at Capodistria at the termination of the Italian Congress of Hydrology.

PROFESSOR W. A. LOCY, head of the department of zoology at Northwestern University, has died at the age of sixty-seven years.

DR. SELIAN NEUHOF, formerly professor of clinical medicine at Fordham University Medical School, known for his work on cardiac diseases, died on October 6, aged sixty-three years.

DR. A. G. MCGOUGAN, professor of physics and head of the department of physics in the University of Saskatchewan, died on September 28.

THE American Mining Congress will meet at Sacramento, California, from September 29 to October 4, for its twenty-seventh annual convention.

THE seventh annual meeting of the American Dietetic Association was held at the New Ocean House, Swampscott, from October 13 to 16. The program was divided into four sections—administrative, educational, dietotherapy and social service, one day having been set aside for each section. In addition to the program there was a commercial and non-commercial exhibit.

THE Geneva Agricultural Experiment Station has received a "Grand diploma" from the Italian government in recognition of its work in behalf of the dairy industry of the world. The diploma was awarded at the first international dairy exhibition held at Milan.

AN appropriation of $10,000 has been made by the Boston City Council to enable Dr. W. T. Bovie, of the city's Medical Conservation Bureau, to carry on experiments with ultra-violet light in the treatment of rickets, tuberculosis and some skin diseases. The money will be used for building and equipping a laboratory on Huntington Avenue adjacent to the biophysical laboratory.

AT the University of Minnesota the corner-stone has been laid for an institute for cancer research, to be erected at a cost of $250,000.

THE United States forestry department intends to purchase 2,000 acres of burnt over plains lands in Michigan for a reforestation project. Norway pine is to be planted.

AT the autumn meeting of the Institute of Metals, the president, Professor T. Turner, announced that a donation of £1,000 had been made by an unnamed friend of the institute to meet the needs of the increasing membership. The council will consider its use as the basis of an endowment fund.

SCHOOLS of forestry are to be established at the University Colleges of Auckland and Canterbury by the New Zealand government, which will make a grant of £1,000 a year, with an additional £600 towards the cost of initial equipment.

A NEW research farm of 350 acres at Wrea Head, near Scarborough, has been placed at the disposal of the University of Leeds by Mrs. Ellis, widow of the late Hon. John E. Ellis. The farm is being used for carrying on experiments in milk production.

THE British government has decided to provide a further sum of £500,000 for agricultural education and research in addition to the funds already available for that general object, amounting to £1,000,000, under the Corn Production Acts and about £400,000 per annum from other government funds. It has been arranged that this new money will be paid over to the Development Fund by the treasury as required, and that it may be looked upon as provided for use during the next five years. The ministry is framing proposals for various schemes to be assisted from this new money. Already certain awards of grants in aid of research into specific agricultural problems have been made by the ministry for the academic year 1924–25.

A SUM of 55,000 francs has been received by the Brussels University Library from the Professor Léon Stiénon Commemoration Fund. The income will be devoted to the purchase of the principal medical periodicals.

THE Geological Survey, Department of the Interior, as a part of its work of determining the location and extent of the natural resources of the country, has

made a survey of Yampa River from Craig, Colo., to its junction with Green River, near the Colorado-Utah boundary, a distance of about 130 miles. A report has been prepared on the possibility of developing power and storing water on this stretch of the river. No power is now being developed in this stretch and, owing to the shortness of the growing season and the poor facilities for transportation, little agriculture is practiced in this region. Although the river is capable of furnishing a large amount of power, there is no market for such power at present, nor are the prospects good for a market in the near future. If, however, a demand should be created by the electrification of railroads or by the construction of a superpower system connecting several units of power with an established market, the development of power on this river would be profitable.

Buildings have been completed and the required equipment obtained for the scientific investigation of distemper in dogs. Situated in England at the farm premises of the National Institute for Medical Research, near Mill Hill, the designing of the dog kennels and runs of the hospital for infected dogs and of their equipment, and the work of obtaining and managing a stock of dogs suitable for the necessary experimental work have been in the hands of Professor Buxton, working in cooperation with Major G. W. Dunkin, who has now taken his place as superintendent at the Medical Research Council's Field Laboratory. The special studies of "filterable viruses" associated with distemper have been entrusted to Dr. W. E. Gye and Dr. P. P. Laidlaw, members of the scientific staff of the Medical Research Council, with the cooperation in particular technical directions of Dr. C. C. Dobell, Dr. J. E. Barnard and others. The statistical investigation of selected outbreaks of distemper occurring in different parts of the country is being carried out under the advice of Dr. John Brownlee, of the staff of the Medical Research Council, and Dr. Major Greenwood, of the Ministry of Health.

Extensive investigations of engineering problems affecting public utilities are to be carried out by the engineering experiment station of the University of Illinois in cooperation with a utilities research committee representing several of the largest utility companies operating in Illinois, according to an announcement by W. L. Abbott, chairman of the committee and chief operating engineer of the Commonwealth Edison Company. The committee is to furnish $25,000 a year for two years, and the university will furnish scientists, laboratories and equipment. Investigations on the fatigue of structural parts will include studies of the wear on axles, fans and other moving parts. Experiments with porcelain will be carried on with a view to increasing the efficiency of insulators. Refractories for water-gas furnaces will be investigated and studies of boiler-feed-water treatment will include an examination of the effect of various waters on the structural part of boilers.

According to *Nature*, the Ramsay Memorial Fellowship trustees have made the following awards of new fellowships for the session 1924–25, the place at which the award is tenable following the name of the fellow in each case: British Fellowship of £300 to Mr. S. W. Saunders, University College, London; Glasgow fellowship of £300 to Mr. A. Robertson, University of Manchester; Danish fellowship of £229 to Mr. K. J. Pederson, University of Bristol. The following fellowships have been renewed: Dr. S. Coffey (British fellowship), University College, London; Dr. A. Titley (British fellowship), University of Oxford; Mr. Thomas S. Stevens (Glasgow fellowship), University of Oxford; Dr. Miguel Crespi (Spanish fellowship), University College, London; Dr. J. Kalff (Netherlands fellowship), University of Manchester; Dr. H. Weiss (French fellowship), Davy-Faraday Laboratory, Royal Institution; Dr. E. Boomer (Canadian fellowship), University of Cambridge. Sir Robert Robertson has been appointed a member of the Ramsay Memorial Advisory Council in succession to the late Sir James Dobbie.

The *Journal* of the American Medical Association states that the Clinical Bureau of Information of the New York Academy of Medicine has been collecting data from hospitals and clinics of Greater New York for a booklet for the guidance of physicians interested in the local facilities for postgraduate clinical study. The bureau has also taken over and is expanding the work started years ago by the New York Association for the Development of Postgraduate Medical Education. It plans to collect information with reference to opportunities for clinical postgraduate work in large cities of the United States, England and on the continent. Several of the foreign clinics are now regularly supplying the bureau with data as to their schedule of work and facilities.

As a needful step at this time in the program of the Lake States Forest Experiment Station for the study of tree planting, the station will start a careful survey of all the planting work that has been done in past years in Minnesota, Wisconsin and Michigan. It is felt that while the task of restoring to usefulness the 20,000,000 acres of denuded forest land in these three states is yet in its infancy, enough has already been done by various federal, state and private agencies to form a basis of very profitable study. The survey as planned will help to determine the extent to which forest planting is advisable and how it can profitably be increased. The plantations to be examined include those of the United States Forest

Service on the Michigan and Minnesota National Forests, and similar plantations by the Michigan Department of Conservation, the Michigan Agricultural College, the Forest School of the University of Michigan, the Minnesota State Forest Service, the University of Minnesota and the Wisconsin Conservation Commission.

UNIVERSITY AND EDUCATIONAL NOTES

A gift of $475,000 to the division of chemistry of Harvard University has been made by the family of the late E. C. Converse, of New York. The money will be used for the erection of a chemical research laboratory at the university.

Yale University will receive $152,679 from the estate of Dr. Plimmon H. Dudley, consulting engineer of New York, to establish what is to be known as the Dudley professorship of railroad engineering.

Bequests contained in the will of Charlotte J. Hillyer, of Hartford, Connecticut, include the following: $25,000 to Yale University; $50,000 to Trinity College; $5,000 to Roanoke College, of Salem, Va.; $2,500 to Elmira College for Women, Elmira, N. Y., and $65,000 to Smith College.

By the will of H. L. Bridgman, regent of the University of the State of New York, who died recently, the university will receive his estate, estimated at about $15,000, after the death of Mrs. Bridgman.

Professor Alexander Findley, professor of chemistry at the University of Aberdeen, Scotland, has accepted an appointment as acting professor of chemistry at Stanford University during the winter, spring and summer quarters of the present academic year.

Dr. Frank E. Ross, who has been for the past nine years a member of the staff of the research laboratory of the Eastman Kodak Company at Rochester, has been appointed associate professor of practical astronomy in the University of Chicago.

Dr. Nathaniel Allison, of St. Louis, has been appointed professor of orthopedic surgery at the Harvard Medical School and Dr. David Harold Walker, Boston, Augustus Lecompte professor of otology.

E. F. Phillips, apiculturist of the Bureau of Entomology, has accepted a position as professor of apiculture in the New York State College of Agriculture at Cornell University. J. I. Hambleton, of the Bureau of Entomology, will have charge of the bee culture investigations of the bureau.

Professor Leon E. Jenks, who was recently in charge of the course in general chemistry during the absence of Professor Frederick E. Breithut at the College of the City of New York, has been appointed professor of chemistry at the Worcester Polytechnic Institute. Dr. M. E. Smith, chief analyst in the food and drug laboratory of the Dominion Department of Health at Halifax, has been appointed instructor in the same department.

Dr. J. V. Hofmann, for eleven years director of the Wind River Forest Experiment Station of the United States Forest Service which serves the Pacific northwest region, has resigned to accept the professorship of silviculture and forest management at the Pennsylvania State Forest School at Mont Alto, Pennsylvania.

Dr. Eugene R. Whitmore, professor of bacteriology and preventive medicine in George Washington University Medical School, has been appointed professor of bacteriology and pathology in Georgetown University School of Medicine and pathologist to Georgetown University Hospital, Washington, D. C.

Professor Thomas M. Bains, Jr., head of the department of mining and metallurgy of the University of Illinois, has gone to the Colorado School of Mines in Denver.

The leave of absence granted to Dr. W. Lee Lewis by Northwestern University has been extended to September, 1925. During this period his courses will be given by Professor C. D. Hurd, formerly of the University of Illinois.

Dr. F. R. Griffith, Jr., has been promoted to associate professor of physiology and Dr. E. C. Albritton has been appointed associate in physiology at the University of Buffalo.

Dr. Saul B. Arenson, instructor in the department of chemistry at the University of Nebraska, has joined the faculty of chemical engineering at the University of Cincinnati.

DISCUSSION AND CORRESPONDENCE

THE GENUS CAMBARUS IN CALIFORNIA

A few months ago I received from Miss Pirie Davidson information concerning the presence of crayfishes in a stream near Pasadena, California. In response to my request several specimens representing both sexes were sent me for identification. An examination of the gill formula and other characters showed that the crayfishes belonged to the genus Cambarus, and the species was later identified by means of the excellent description and figures in Hagen's "Monograph of the North American Astacidæ" as *Cambarus clarkii* Girard.

This is the first time that a species of Cambarus

has been reported from one of the western states. All the other west American crayfishes are members of the genus Astacus, while all the crayfishes of the United States east of the Rocky Mountains belong to the genus Cambarus, with the exception of *Astacus gambelii,* which ranges across the divide from Utah and Idaho into Montana and Wyoming, where it is found in the upper tributaries of the Missouri River.

Cambarus clarkii has been previously reported from Texas and several other southern states, and it is an interesting fact that this is one of the species of Cambarus whose previously known range approaches most closely the southern part of California. Nevertheless, the Californian and the Texan representatives of this species are separated by a long, arid stretch of over 800 miles. This is a quite unusual discontinuity in the distribution of a species, but it is possible that other specimens may be found in some of the small streams of the intervening territory in Arizona and New Mexico. It is also possible that the forms may be artificially introduced, although crayfishes are not commonly distributed in this manner. A species of crayfish would encounter many difficulties in extending its range across the deserts which lie between southern California and Texas, unless it migrated in a period when the rainfall was much more plentiful than it is at the present time.

S. J. HOLMES

UNIVERSITY OF CALIFORNIA,
BERKELEY, CALIFORNIA

ON BOTANY ON THE CAMPUS

PROFESSOR TRELEASE, in his article in SCIENCE for August 1, calls attention among many other interesting things to the need of introducing the embryo agriculturist to plants as they grow, and to the European botanical gardens which serve the purpose. Isn't it conceivable that something of the sort might be done under American conditions? I think any aggressive botanical department would be glad to do the work if it had any reasonable hope that the plantings would be permanent.

Here there have been a number of fine groups of native and introduced plants that have been used for such instruction. But they have no protection from the administrative authorities in charge of the campus; and even in the few years I have been here a large proportion have been either dug out with a steam shovel or buried under twenty feet of earth, sometimes to make way for something equally or more useful, but frequently merely to straighten a drive or level a piece of ground. This spring one of the two small areas of natural shrubbery on the main campus was slashed off, and most of the trees also cut down, without even the excuse of any construction on the site, but apparently merely because it was in the neighborhood of a new building that was going up. (A *dead* hickory was left standing alone.)

I wonder if there is hope of sufficient reform in grounds administration to make the building up of a collection of the necessary types of plants a possibility. I imagine conditions are no worse here than on most rural campuses. The problem on a crowded city campus will be largely of a different sort.

WM. T. M. FORBES

CORNELL UNIVERSITY

OSMOSIS DEMONSTRATION FOR BIOLOGY CLASSES

DR. CLAYBERG'S observation regarding the demonstration of osmosis set up by biology teachers (SCIENCE, LX, 100, August, 1924) that "sometimes the thing does not work," applies unfortunately over a large part of these United States. I have found teachers of all degrees of intelligence and training shy at the demonstration as usually described in the textbooks, and resort finally to the classic egg and sealing wax, which is confusing to the student rather than illuminating. The chief practical difficulty is apparently that of attaching a membrane to the funnel or thistle tube so as to leave no leaks.

The use of celloidin bags I find eminently satisfactory. Although this has been repeatedly described in technical literature, teachers seem to be afraid to try it because they were not themselves taught it in school or college. But it is easy enough after one or two trials.

This method consists of: (1) preparing the celloidin bag before the class: Pour some "newskin," celloidin dissolved in ether-alcohol, free from acetone, into a four-ounce wide-mouth bottle, dry; pour out again all you can, back into the container, rotating the bottle constantly, slowly, so as to spread a very thin layer of the celloidin over the entire inside surface; remove ether and alcohol by ventilating inside of bottle—that is, blow into it several times; after the odor of ether is gone, rinse out with water, which removes most of the alcohol; gently work out the membrane, beginning at the neck of the bottle, pouring a little water between membrane and glass—the whole skin can be removed without breaking it. (2) setting up the "artificial cell" or "root hair": Insert a No. 4 or No. 5 rubber stopper, two holes, in the neck part of the bottle-shaped celloidin capsule; insert thistle tube into one hole of stopper; pour in sirup or whatever solution you intend to use until bag is quite full and overflowing; plug second hole; suspend in water—use clamp on ringstand, holding at level of rubber stopper.

To fasten bag to stopper, I find either several windings of rubber band or cementing with fresh celloidin solution satisfactory. The thistle tube may be re-

placed with a yard or two of glass tubing to get a higher lift. This whole outfit can be set up and show a rise of several inches to a foot or more within the usual forty-five minute period. It is free of complications necessarily present in the egg or parchment; it holds the interest of the students; it simplifies the problem and facilitates understanding. And it really takes less time than the other demonstrations. Bags prepared in this way in advance may be kept indefinitely suspended in sterile water, with the rubber stoppers in place ready for instant use.

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NEW YORK, N. Y.

DISCUSSIONS AT SCIENTIFIC MEETINGS

THIS is to voice the sentiments of many scientists with whom the undersigned has spoken concerning the machine-like method with which our scientific meetings are conducted. Time was and not far distant in the past when each paper was given critical examination and rarely indeed did a conclusion escape open-air discussion, with the result that erroneous conclusions did not bear the weight of conviction from having been presented to some august society and the conclusion not challenged. In the days when the Society for Experimental Biology and Medicine was enlivened by the searching criticisms of men like Lusk, Jacoby, Meltzer and others, both profit and pleasure resulted. It is common, at the present time, for the presiding officers of our societies to announce that eight minutes are available for the reading of a paper and two for discussion. The logical method would be to reverse this program.

Any attempt to limit the number of papers entails difficulties, but they are not wholly unsurmountable. If we keep clearly before us what value we expect from the reading of papers, our criterion is set. Then we may entrust to a selected group of men (or to a single member) the designation of a relatively few papers bearing the stamp of importance, or of some especial virtue such as promise, or even to further the work of some young and promising worker. There are always men who will place their own benefits above those of the majority, and they will be offended by not having their papers selected. There will always be papers embodying important factors which, because they are not evident, are passed by. However, in the long run, ten papers critically examined are preferable to double the number passed through the program like the film in a movie.

A decigram of discussion is worth a kilo of pulpwood paper required to print erroneous conclusions and faulty technique.

W. M.

LANSDOWNE, PA.

HEARING AND NOISE

IN the article on "Graduated amplifiers as an aid to hearing" in the June 20th number of SCIENCE appears this statement: "The fallacy that deafened persons can hear better in noisy surroundings was disposed of by Dr. Fletcher," etc.

The truth of the matter is that people who are deaf because of fixation of the foot plate of the stapes often do hear better in noisy places, as every otologist knows.

I recall one man who was so deaf I had to shout to make him hear, yet he stated that he could hear a pin drop in a boiler shop. Another patient, who was also quite deaf, said she could hear perfectly if the piano were being played.

G. W. BOOT

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SOME REMARKS ON THE LITERATURE OF RUST FUNGI

WHILE reading various mycological publications, the writer has noticed certain errors and omissions in reference to matters of fundamental importance, to which he wishes here to call attention and also to add some comments that may be of interest, bearing upon the same or similar subjects.

On page 202 of Harshberger's text-book,[1] which, by the way, is one of the best books of its class that the writer has read, it is stated that the black stem rust of wheat (*Puccinia graminis tritici*) occurs seldom on barley, whereas it is the common stem rust of barley, as well as of wheat, in the United States. Eriksson is evidently meant to be authority for the statement, as it is repeated on page 562, and there directly credited to him. Nevertheless, in 1899 the writer published results,[2] showing that barley stem rust and wheat stem rust are the same. (This publication is not included in the bibliography of the book.) Dozens of investigators have since confirmed these results, and yet others have made this same error of statement. To state an elementary fact, that should be generally known, but apparently is not, there are in the United States (1) a form of black stem rust very common on barley and wheat, (2) another distinct form on rye and rarely on barley, and (3) a third distinct form on oats, each of these being found

[1] Harshberger, John W., "Mycology and Plant Pathology," XIII + 779 pp., 271 ills., P. Blakiston's Son & Co., Philadelphia, 1917.

[2] Carleton, Mark Alfred, "Cereal rusts of the United States, a physiological investigation," U. S. D. A. Div. Veg. P. & P. Bull. 16, 74 p., 1 fig., 4 col. pl. Bibliogr. pp. 70–73, 1899.

also on various wild grasses. This leaves out, of course, the various sub-forms of each of these that are being constantly found. In Sweden, the barley-rye form is apparently the common one on barley, rather than the barley-wheat form, probably because of the greater proportion of rye to wheat grown in that country than in the United States. Even in the latter country, the barley-rye form may be more frequent on barley to the northward, where there is proportionally more rye grown, though Fraser, in a recent publication in Canada,[3] gives it no emphasis and does not state that it is found on barley at all. A rust may specialize geographically as well as with reference to host plants. Stakman, Levine and Bailey call attention[4] to an additional instance in the fact that the oat stem rust is exceptionally virulent in Sweden. In view of these facts, and the writer supposedly having done careful work, why should other American writers follow the presentation of specialized forms proposed by Eriksson, applicable only to Sweden, rather than that proposed by him applicable to the United States?[5]

The point raised is not at all a minor one, but of the greatest practical importance, for a large share of responsibility for the spread of wheat stem rust may belong to the occurrence of this rust on barley and particularly on wild barley. Wild barley is common and widely distributed in all the Great Plains from Texas to Canada, and nearly always carries the wheat stem rust, frequently in great abundance, when growing near wheat fields. This and certain other wild grasses may especially provide a means for the over-wintering of the rust in the spring wheat district. The writer found germinable spores on wild barley near Fargo, N. D., late in November. Fraser states[6] that he is still investigating methods of over-wintering, and that he has no evidence that spring infection arises from the barberry. Several wild wheat grasses also carry the rust, of which the most important is probably *Agropyron tenerum*.[7]

[3] Fraser, W. P., "Seasonable hints," Prairie Edition, No. 26, July, 1923, p. 7, Ministry of Agriculture, Ottawa.

[4] Stakman, E. C., M. N. Levine and D. L. Bailey, "Biologic forms of *Puccinia graminis* on varieties of Avena spp.," *J. A. Res.*, 24: 1013–1018, 4 pl., 1923.

[5] It may be worth while to state here that, while the discovery of biologic specialization of rusts must be credited to Eriksson, because of priority of publication, his and the writer's investigations, covering almost exactly the same ground, were absolutely independent of each other and practically simultaneous. The writer was unaware that any other one was doing the same kind of work, until his own data were ready for the press.

[6] Anonymous, "Breeding wheat to resist rust," *Northw. Miller*, 126, 296, 1921.

On pages 191 and 561 of the same text-book above mentioned, there is much confusion and error of statement in respect to the amphispore. This spore form, discovered by the writer, is in no way identical with the urediniospore, as there stated, but, as its name implies, apparently assumes the functions of both the urediniospore and teliospore. It is quite distinct from any other known spore form of the uredinales. In the writer's own experience, there is only the one instance of its occurrence,[8] that is, in the species *Puccinia vexans* on mesquite grass, but Arthur[9] has since described other instances of its occurrence in other grass and sedge rusts. It is claimed by no one, in the writer's knowledge, that either the amphispores or the urediniospores are responsible for the over-wintering of the wheat stem-rust, as intimated in the pages above cited—not the former, because they do not occur in that species of rust, and whether or not the latter are so responsible is a leading question, the correct answer to which will be of wide interest.

In another book, written by Stevens,[10] which also the writer has found to be a good book in several respects, there are nevertheless errors, as might be expected in such a book, whoever the author. The chief error, of concern to the writer, is at bottom of page 382, where the author says, under description of *Puccinia triticina*, "This species is combined with *P. triticina*, by Carleton," in which sentence he evidently meant to say *P. rubigo-vera*, it being a typographical error. However, the entire paragraph is not clear, and, taken in connection with the author's acceptance of *P. triticina*, but not of *P. dispersa*, and his statement under *P. glumarum*, which is generally considered to be quite distinct from any other species, makes it difficult to determine what idea it is intended to convey as to these forms. It may be well to state here, for the first time, the idea of the writer as to the relationship of these two rusts, in his publication

[7] It must not be inferred from these statements that the writer is skeptical as to good results from the barberry eradication campaign, as such campaign, on the part of the U. S. Government, was initiated by him, and he, in company with Bolley, Stakman and Buller, framed the first state law (in North Dakota), since that of Massachusetts, to compel the destruction of that plant. Also, he alone (in absence of a state pathologist) drafted a similar one for South Dakota, which was approved by the experiment station agronomist, but whether or not this draft is the one later enacted as law is not yet known to him.

[8] Carleton, Mark Alfred, "Investigations of Rusts," U. S. D. A. Pl. Ind. Bull. 63, 1904.

[9] Arthur, J. C., "Amphispores of grass and sedge rusts," Bull. Torr. Bot. Club. 32, 35–41, 1905.

[10] Stevens, F. L., "The Fungi which Cause Plant Disease," VIII + 754 pp. 449 ills. The Macmillan Company, New York, 1921.

first referred to above, which was as follows: The complex previously known as *P. rubigo-vera*, having been found to include frequently two distinct species, it did not become necessary thereby to establish *two* new names where there was only *one* new species. Accepting, therefore, the name *P. glumarum* for the new species, the writer simply retained the old well-known name *P. rubigo-vera* for the common brown rust of wheat and rye, proposing, however, the two names, *P. rubigo-vera tritici* and *P. rubigo-vera secalis*, for the respective biologic forms on these hosts.

In *Botanical Abstracts* there is reference to a paper by Mains[11] on the seed carriage of Euphorbia rust, which recalls very similar experiments of the writer, reported in 1904 in his paper last above cited, pages 28–29. Not having seen the entire article of Mains, it is not known to the writer whether or not his experiments are referred to in that article, but it is true that the writer demonstrated, in careful greenhouse work, the carrying over of rust in the seed of *Euphorbia dentata*, thus proving the existence of a perennial rust in an annual host, the first time in the United States. One other case had at that time been reported from a foreign country.

As already evident from these notes, it seems to the writer a matter of the greatest importance to study the relationship of the rusts of wild grasses, and of these rusts to those on the cereals. Even where the barberry is an important factor between cereal crops, a perennial grass may receive the rust first, from which it will pass on to the cultivated cereal. However, the grass is probably of most importance in over-wintering the cereal rust. It is gratifying to note that already more attention is being given to these grass rusts than previously. Mains[12] has made a good study of Puccinia montanensis and similar species on Elymus and other grasses, and, although heteroecism is the chief subject of discussion, he brings out the important point of over-wintering, apparently unaware of the fact, however, that positive results of observations in that respect had been reported by the writer some time ago in his publication last cited. Mains says:

> The geographic distribution of *P. montanensis*, as indicated by specimens in the herbarium, is British Columbia, Wisconsin, Indiana, southward to New Mexico and southern California, while *Berberis Fendleri* (the aecial host) is limited in its distribution to the mountains of Colorado and New Mexico. Such a difference in distribution, however, would be explained, if this rust is not dependent upon its aecial stage, but is able to over-winter in the uredinial stage. Mr. Bethel has made observations in Colorado which indicate that such an over-wintering may occur there.

In 1898 the writer observed that this rust wintered in the uredo stage on the University Farm at Lincoln, Nebraska. No urediniospores were germinated, but the mycelium was vigorous and spreading rapidly, and the spring had well begun. This subepidermal rust, though not occurring on cereals, is a very interesting one, and, in mode of life, is the most similar of all rusts to *P. glumarum*, in the writer's experience. It had been under the writer's observation for a long time previously in Kansas and Nebraska, and its perennial nature suspected.

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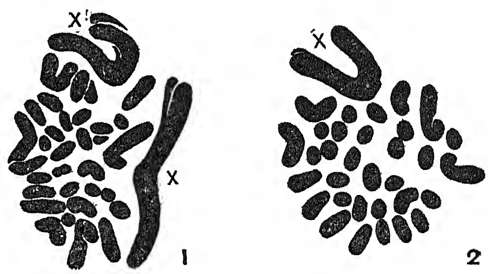
[11] Mains, E. B., "Evidence of the seed carriage of the Euphorbia rusts, *Uromyces proeminens* and *U. dictosperma*," Proc. Indiana Acad. Sci. *1921*: 137–139, 1922.

[12] Mains, E. B., "The heteroecism of *Puccinia montanensis, P. koeleriae* and *P. apocrypta*," *Mycologia*, 13, 315–322, No. 6, Nov., 1921.

LABORATORY APPARATUS AND METHODS

MATERIAL FOR DEMONSTRATIONS OF ACCESSORY CHROMOSOMES

IN most male Orthoptera the accessory chromosome may readily be recognized both in spermatogonial and spermatocyte divisions, but in females the paired accessory chromosomes are usually very difficult to identify. In order to find material suitable for demonstrations of the accessory chromosomes in both sexes the cells of many species of long-horned grasshoppers (Tettigoniidae) have been examined. Since such demonstrations seem to be quite widely desired for class use in zoology and for other purposes, it may be of value to report the result of this examination.



Spermatogonial cells from the testis and follicular cells of the ovary of *Orchelimum concinnum* and *Orchelimum vulgare* were found to be especially favorable. Although the number of chromosomes is rather difficult to determine, there are probably 33 in the male (Fig. 2) and 34 in the female (Fig. 1). The accessory chromosomes are V-shaped and three or four times the size of the largest autosome, as can be seen in the figures (X). Other undetermined species

of the same genus were examined and found to show very similar conditions. The genus has a very extensive distribution and may be obtained practically throughout the United States, being "very common in summer and early autumn in damp meadows and along the margins of streams and ponds."

Keys for determining material may be found in Blatchley's "Orthoptera of Northeastern America" and in Rehn and Hebard's "Synopsis of the Species of the Genus Orchelimum," Transactions American Entomological Society XLI.

In order to obtain many fine spermatogonial divisions, immature males should be killed with a few drops of xylol, the testes dissected out and fixed for three hours or longer in the following fixative, which must be freshly made up:

75 cc saturated aqueous solution picric acid, 15 cc formalin, 10 cc glacial acetic acid, 0.5 gram urea and 1.0 gram chromic acid crystals.

Wash in 70 per cent. alcohol until no longer yellow. Dehydrate clear, infiltrate with paraffin and section 7–8 μ thick. Stain in iron haematoxylin.

Ovaries should be dissected from adult females and treated as above. Since the larger eggs usually crumble when sectioned they should be removed before dehydration. Slides should be differentiated to show polar views of metaphases of dividing follicle cells.

The material is also very suitable for the demonstration of the distinctive differential behavior of the accessory chromosome in spermatogenesis. Since this element is so extraordinarily large its peculiarities in the prophases are particularly striking.

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SPECIAL ARTICLES

THE RELATIVE REACTION OF LIVING MAMMALIAN TISSUES

The methods which have led to a comprehension of acid-base conditions in the blood are for the most part inapplicable to the study of the reaction of individual tissues in the living mammal. This field of inquiry has remained, not closed indeed, but well nigh unentered. The observations which follow indicate that the tissues in general are less alkaline than the blood, and that in some of the organs, on occasion at least, a notable acidity prevails.

Rats and mice can be vitally stained with litmus by repeated injection of it in the purified blue state. The coloration persists for weeks without manifest detriment to health. At first the whole creature becomes blue owing to the amount of indicator present in the body fluids; but soon a striking color differentiation develops. The hairless surfaces now appear violet because of a red-stained connective tissue overlain by a blue-stained epithelium. Long after the indicator has practically disappeared from the body fluids the surface epithelium, the bones, osteoid tissue, cartilage, tendons, aorta and heart valves are still diffusely blue, whereas other tissues, notably the connective tissue everywhere, the liver, pancreas and kidney are of a pronounced rosy red. The red color is almost wholly the consequence of a segregation of litmus in intracellular granules acid in character; and the amount of granular matter may become so great that the predominant reaction in the tissue when crushed is likewise acid to the indicator. In uninjured connective tissue a blue ground-work can be made out between cells laden with the red granules, whereas the parenchyma of certain of the viscera containing macrophages filled with such granules has a ruddy sheen, difficult to discriminate in the presence of these latter, which might be taken to indicate an acid state.[1] Cells with red granules dying here and there in the body are for a brief period colored diffusely blue; and local derangements within elements yet alive are signalized by a change in the tint of individual granules. The acidity of some at least of these granules in which litmus is stored is so considerable that when brom cresol green instead is deposited in them they are rendered yellow, a hue which, under controlled circumstances in the test tube, would indicate an acidity at least as great as pH 4.0.

The sodium salts of the phenol indicators stain living tissues far more rapidly, deeply and diffusely than does litmus; and several are well tolerated, as the event has shown. Mice given thymol blue, which is yellow at pH 8.0 and blue at pH 9.4, become yellow practically throughout, a fact which sufficiently indicates that the range of the indicator is too far to the alkaline side for it to be useful in the present connection. After cresol red (yellow at pH 7.2; purplish red at pH 8.4), the hairless body surfaces are reddish yellow, whereas the tissues exposed when the anesthetized animal is laid open have a clear yellow hue. The plasma of blood removed from the right ventricle into paraffined containers and under

[1] In 1913 (*J. Exp. Med.*, xviii, 183) the writer recorded the fact that some tissues grow well in plasma rendered acid to litmus through their metabolic activities; and Lewis and Felton, Fischer and Mendeléeff have since demonstrated that some survive at a pH as low as 5.5. Stieglitz (*Arch. Int. Med.*, 1924, xxxiii, 483) reports that the kidney cortex of dogs receiving azolitmin intravenously becomes red with the indicator in the course of a few minutes.

paraffin oil is by contrast yellowish red. This finding, of a less alkaline state in the tissues than in the blood, is confirmed with phenol red (yellow at pH 6.6; red at pH 7.8). The circulating fluids of mice injected with this substance are damson colored, whereas an intense yellow suffuses the tissues. With both indicators a significant phenomenon is to be witnessed during the dissection. Almost immediately on exposure to air the connective tissue stained with cresol red becomes more alkaline as shown by a change from yellow through red to rose-purple, while with phenol red not only this tissue but the cartilage, tendons and bony surfaces undergo alterations in hue that are similar in significance. Krogh[2] has shown the ease with which carbon dioxide passes through animal membranes.

Brom thymol blue, the next indicator of the series (yellow at pH 6.0; blue at pH 7.6), stains but poorly and produces an acid intoxication in mice, as is clearly attested by the yellow hue of both blood and tissues in the prostrated animals.

Brom cresol purple, which is yellow at pH 5.2, and purple at pH 6.6, stains the tissues intensely, but the dose necessary for the purpose comes close to that which is lethal. Through its use differences in the reaction of individual organs can be made out such as were foreshadowed by the work with litmus. In animals receiving it, the circulating fluids, the skin epithelium, connective tissue, bone, cartilage, tendons, aorta and heart valves are all rendered intensely purple, whereas the fatty tissue, striped muscle, liver, kidneys, lymphnodes, pancreas and certain other viscera exhibit various shades of greenish-yellow, changing to purple when alkali is applied. There can be no doubt that under the circumstances of the work a considerable acidity prevails in the last-mentioned group of organs. The color nuances to be observed in many regions of the body constitute a clear-cut tissue differentiation on the basis of differences in reaction. Pre-existing pathological changes are often sharply demarcated by colors that attest to abnormalities in the tissue reaction.

Methyl red is too susceptible to reduction for use during life; and brom cresol green, which possesses much the same range (yellow at pH 4.0; blue-green at 5.6), colors the tissues an intense blue-green, sufficient evidence that this range lies too far to the acid side for successful utilization.

The phenol indicators are excreted in large part through the bile; and the hue of the intestinal contents, which are stained in consequence, alters with the conditions at the different levels of the gut.

The information given by the indicators available at present for injection into living animals must be accepted with caution. Even the best of them is influenced by the substances with which it comes in contact; and little is known of the effects on the body of the majority of them. But the findings here set forth will serve perhaps to point the way to more conclusive studies. They emphasize the need for color methods whereby the manifold physiological differentiations within the living body can be disclosed with something of the certainty that now obtains for morphological ones.

Details of the work will appear in *The Journal of Experimental Medicine.*

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[2] Krogh, A., *J. Physiol.*, 1919, lii, 391.

DIRECT SYNTHESIS OF HIGHER FROM LOWER HYDROCARBONS[1]

IN examining the stability of gaseous ethane at normal pressure under the α-radiation of radon (radium emanation) mixed with it in a small glass sphere (1.7 cm diameter), a liquid phase appeared after the first day's radiation. Since nothing was initially present in the glass vessel except ethane confined over mercury (having contact with the ethane in a capillary connecting tube) and the infinitesimal quantity of radon (222.5 millicuries = 0.12 cubic millimeters and a pressure of 0.8 mm of foreign gas), it was evident that ethane was being converted into one or more of the higher hydrocarbons. The quantity of liquid hitherto obtained is too small for positive identification, but has about the vapor pressure of octane, which is the lowest member of the paraffin series that would form a liquid having the low vapor pressure observed at room temperature.

If the product is octane, the reaction which apparently takes place is $4C_2H_6 = C_8H_{18} + 3H_2$, which might take place in two stages with butane as the intermediate product. It is also not impossible that the product may be an unsaturated or a ring compound produced by splitting out more hydrogen.

The liquid was reddish-brown in color, most probably due to colloidal carbon, which shows that decomposition into carbon and hydrogen must also take place to some extent. Abundant hydrogen was shown to be present. After a few days, during which time the total pressure continued to increase, nothing remained except hydrogen and liquid generally distributed over the walls of the vessel in fine droplets, and forming a minute liquid column in the capillary tube at the bottom of the vessel. The pressure con-

[1] Published with permission of the Director of the U. S. Bureau of Mines.

tinued to rise, indicating the liberation of further hydrogen by the direct action of alpha particles on the droplets of liquid. No sign of solid hydrocarbons appeared.

According to ionization the reaction mechanism may be interpreted as follows. The primary reaction is the removal by alpha particles of electrons from molecules of ethane:

$$C_2H_6 = C_2H_6^+ + 1\,e$$

The resulting active ethane ion forms complexes by addition of ordinary neutral ethane molecules:

$$C_2H_6^+ + C_2H_6 = (C_2H_6)_2^+$$

or

$$C_2H_6^+ + 3C_2H_6 = (C_2H_6)_4^+$$

Upon electrical neutralization by free electrons (from the original ionization) hydrogen would be split out, giving butane or octane as the case may be.

The reaction appears to possess interest from several angles: (1) It appears to confirm the hypothesis of complex formation by ions proposed by one of us at the Dayton meeting of the American Electrochemical Society (Trans. *44*, 63–71 (1923)). (2) It is the first instance of a method of directly synthesizing higher from lower hydrocarbons, by α radiation. (3) It will be of interest to see whether contact catalysis will be found to produce the same reaction in larger quantity. (4) The possibility is suggested that the same complex may break down in two or more ways, giving different products. It will be important to determine how these ways may be influenced or controlled, as having a possible bearing on the cracking of hydrocarbons. (5) Since α-radiation is present everywhere in the earth's crust, it is evident that a process is at hand in nature by which lower hydrocarbons could be stepped up to higher ones, as well as broken down. However, the complete absence of free hydrogen in natural gases and petroleum remains to be explained.

A more detailed study of this and similar reactions is under way, in which it will be undertaken to determine what fraction of the primary reaction results in higher hydrocarbons and what in complete decomposition to hydrogen and carbon.[2]

S. C. Lind,
D. C. Bardwell

[2] The possibility of synthesizing higher from lower hydrocarbons by silent electrical discharge was long ago discovered by Berthelot (Comp. rend. *126*, 568 (1898)). Professor Boltwood (private communication) informs us that in work on the production of helium from radium he and Professor Rutherford had occasion to confine radon by a solid plug of paraffin. After several days large quantities of hydrogen were found to have been given off and the paraffin plug could no longer be melted, even by heating almost to the softening point of the glass.

NICOTIANA RUSTICA AS A SOURCE OF NICOTINE FOR INSECT CONTROL[1]

The value of nicotine preparations for the control of aphids, leaf hoppers, red spiders and many other insects has long been recognized. The general interest in these preparations, however, has been greatly stimulated in recent years, owing to the experimental work of Smith[2] and many others on the use of natural and artificial nicotine dusts, with the result that more nicotine is used as an insecticide at the present time than ever before.

Nicotine for insecticidal purposes is derived almost entirely from stems, stalks and waste leaves of commercial types of tobacco of low nicotine content. This source of supply is dependent on the amount of tobacco wastes used for other purposes. Under the existing conditions, therefore, the cost of nicotine preparations, must, of necessity, be relatively high.

Realizing the importance of augmenting the natural supply of nicotine, the U. S. Bureau of Plant Industry, in cooperation with the Pennsylvania State College, started experimental work in 1914 on the practicability of cultivating tobaccos for their nicotine content alone. Various types of "high nicotine" tobaccos were used but were soon discarded, with the single exception of *Nicotiana rustica,* a leathery tobacco unsuited for the usual purposes of manufacturing and possessing an extremely high nicotine content. The nicotine content of these plants has since been increased by processes of selection.

In the fall of 1923, a number of carefully selected fairly mature plants of this type were sent to the Pennsylvania State College by Mr. Otto Olsen (expert in charge of tobacco investigations at Ephrata, Pennsylvania), with the request that studies be made on the whole plants relative to their nicotine content and utilization for insecticidal purposes. These plants came from Lancaster and Clinton Counties, Pennsylvania, and had received the same fertilizer treatment. Some of the plants had been topped, while others were kept free of suckers during their growing season. Several were both topped and suckered and the remaining plants were untreated. The whole plants, minus their root systems, were dried, weighed and analyzed for nicotine according to the method of Shedd.[3] The results obtained are given in the following table and are calculated on a water-free basis:

[1] Published as Paper No. 12, Department of Agricultural and Biological Chemistry, the Pennsylvania State College.

[2] Smith, R. E., "The preparation of nicotine dust as an insecticide." Univ. Cal. Pub., Bull. No. 336. 1921. pp. 261–274.

[3] Shedd, O. M., "An improved method for the determination of nicotine in tobacco and tobacco extracts." *Jour. Agr. Res.*, Vol. 24, No. 11. 1923. p. 963.

Number of plants	Nature of treatment	Grams of dry matter per plant	Nicotine	
			Percentage	Grams per plant
3......	Topped	170	2.75	4.68
5......	Suckered	144	3.79	5.46
11......	Topped and Suckered	124	4.40	5.46
5....	Untreated	144	1.61	2.32

Close similarities were observed between the nicotine content of the leaves and stalks of the topped and suckered plants from the two localities as evidenced by the analysis of composite samples as given below:

Location	Percentage of Nicotine	
	In stalks	In leaves
Lancaster County	2.05	7.30
Clinton County	2.22	7.05

The weight of tobacco produced from an acre of Nicotiana Rustica grown in Clinton County in 1923 amounted to 4,500 pounds, slightly more than our results indicate, assuming 11,000 plants per acre. Owing to individual characteristics of plants one would not expect the weights of different plants to closely parallel one another. In every case, however, when the plant had been either topped or suckered the percentage of nicotine was very much higher than that of an untreated plant. These results are in more or less agreement with those obtained by Oosthuizen.[4]

According to Shedd and Olney[5] nicotine can be readily extracted from tobacco wastes by steeping the material in cold water. Experiments conducted by us have substantiated their claim. We have found, however, that nicotine can be obtained more readily by treating the tobacco with cold water and bringing to a boil and filtering through cheesecloth immediately. A very few washings with hot water freed the residue of nicotine, while continued boiling of the sample was not so satisfactory. After the nicotine was extracted solutions were made up in concentrations varying from 0.06 to 0.2 per cent. nicotine. When mixed with a little soap these solutions were found to possess pronounced aphiscidal properties, comparable to the results obtained from the same concentrations of nicotine solutions made by diluting a standard 40 per cent. nicotine solution.

4 Oosthuizen, J. du P., "Tobacco cultivation for nicotine," Union of S. A., *Jour. Dep't. Agr.*, Vol. 6, No. 2, 1923, p. 173.

5 Shedd, O. M. and Olney, A. J., "The preparation from tobacco of a solution for spraying," Paper presented before the 67th meeting of the American Chemical Society, 1924.

Further studies relative to the utilization of *Nicotiana rustica* are being conducted by us at the present time.

D. E. HALEY,
F. D. GARDNER,
R. T. WHITNEY
PENNSYLVANIA STATE COLLEGE

THE WESTERN PSYCHOLOGICAL ASSOCIATION

THE fourth annual meeting of the Western Psychological Association was held at Stanford University on August 8 and 9.

The officers for 1923–24 are as follows: Edmund S. Conklin, *president*, University of Oregon; Arthur H. Sutherland, *vice-president*, Los Angeles Schools; Walter R. Miles, *secretary-treasurer*, Stanford University; Calvin P. Stone, *local committeeman*, Stanford University.

The program was as follows:

Heredity, environment and mental achievement: TRUMAN L. KELLEY.

The geography of intelligence: RAYMOND FRANZEN.

Character and personality traits of gifted children: LEWIS M. TERMAN.

Intellectual factor in children's drawings: FLORENCE L. GOODENOUGH.

The validity of self-estimate: EUGENE SHEN.

The determiners of animal learning: EDWARD C. TOLMAN.

The problem of psychological set: PAUL THOMAS YOUNG.

Psychological systems in their relationship to selling: EDWARD K. STRONG, JR.

Description of eidetic phenomena: HEINRICH KLUVER.

A rotation table for laboratory animals: FRANKLIN S. FEARING.

Review of alcohol studies: WALTER R. MILES.

The classification of personalities: EDMUND S. CONKLIN.

Nervous and mental characteristics of Mongolian imbecility: KATE BROUSSEAU.

Freudian theory and sexual enlightenment: a study in resistances: CAVENDISH MOXON.

Intelligence tests of Los Angeles police force: ELLEN SULLIVAN AND GRACE FERNALD.

Some results on the development of mental control: A. H. SUTHERLAND.

Congenital behavior following cerebral lesions in rabbits: CALVIN P. STONE.

Psychological research in state institutions: FRED NELLES.

Educational achievement of children with personality and behavior difficulties: PHYLLIS BLANCHARD, RALPH P. TRUITT AND RICHARD H. PAYNTER, JR.

The analytical vs. the general diagnosis in clinical psychology: LIGHTNER WITMER.

The new type of functionalism: WALTER B. PILLSBURY.

SCIENCE

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THE BEGINNING OF THE SCHOOL[1]

IT is appropriate, upon this occasion, that reference should be made to the condition of scientific education in this country at the time of the foundation of the institute and that an outline of its early history should be given.

At the beginning of the nineteenth century the study of the physical sciences in the United States was in its infancy. Scarcely any provision was made for scientific instruction in any of the colleges of the country. Astronomy, physics, chemistry and botany had indeed been taught, during the preceding century, in a few institutions of learning, a department of mathematics and natural philosophy having been created in Harvard College as early as 1727, a professorship of botany in Columbia in 1792 and a class of chemistry at Princeton in 1795. Instruction had also been given in physics and chemistry in the University of Pennsylvania and Dartmouth College and in physics in Union College. This short list, however, includes all the colleges which had given the physical sciences more than an insignificant place in their curriculums. Even in these the instruction was given by lectures, supplemented, at times, by experiments which the teachers performed. Anything approaching laboratory work by the student was almost wholly unknown. When Professor Silliman was elected, in 1801, to the chair of chemistry, geology and mineralogy in Yale College, he visited Dr. McLean, who was professor of chemistry at Princeton, and there for the first time saw experiments in chemistry performed. Considering the state of scientific knowledge at this period and the general lack of opportunity for the study of science, even in Europe, it is not remarkable that this should have been the case in a new country, the total population of which, in 1800, was less than that of the city of New York to-day.

With the general awakening to the value of a knowledge of the natural sciences, during the first quarter of the nineteenth century, came provision for their study in other of the academic schools of the country. Within that time courses in various branches were inaugurated at Yale, Williams, Bowdoin, Dickinson, William and Mary and Hobart Colleges, and in the universities of Georgia, North Carolina and South Carolina. Facilities for practical

[1] Address of the president at the centennial celebration of Rensselaer Polytechnic Institute, Friday, October 3, 1924.

work by the students were still wanting in nearly all of them, though the apparatus used for illustration had grown in quantity and variety. A chemical laboratory, already mentioned, was in existence at Princeton, one was fitted up at Williams College in 1812, and one at Harvard shortly after this date. A few others were also to be found. They were all, of course, crude and unpretending, compared with those thickly scattered over our country to-day.

The time had now come, not only for the addition of scientific courses to the curriculums of institutions of learning, but for a general diffusion of scientific knowledge among those who could not have the advantage of an education higher than that offered by the common schools. Attempts in this direction had already been made in Europe. When Count Rumford returned from Munich to London in 1795 he endeavored to interest the people of England, as he had those of Germany, in his plans for public and domestic economy, more particularly in the economic consumption of coal, improvements in the construction of fireplaces and the heating of buildings by steam. Or as he put it in a circular issued in London in 1799, to interest them in the *application of science to the common purposes of life*. His efforts and those of others in this direction resulted in the establishment, in the year 1800, of the Royal Institution of Great Britain. Other men had not been blind to the benefits which would result if the people generally could be instructed in the application of science to the common purposes of life. Franklin's opinions upon this subject are well known. John Adams believed that the state should make provision for this purpose and Jefferson also proposed a school of technical philosophy, to be maintained wholly at public expense, where various artisans could learn as much of the sciences, as then known, as might be necessary to pursue their work understandingly.

The influence of such opinions gave impetus to the diffusion of scientific knowledge among the people of this country, and during the first quarter of the century two schools were established here avowedly for the purpose of giving instruction in the applications of science. The first was incorporated under the name of the Gardiner Lyceum in Gardiner, Maine, in 1822 and opened in 1823 by Benjamin Hale, who afterwards became president of Hobart College. In his inaugural address, delivered January 1, 1823, this young man, who was graduated only four years before from Bowdoin College, referring to the students to be, said:

> It is not sufficient for them, as for the general scholar, to be taught the general laws of chemistry, they must be instructed particularly in the chemistry of agriculture and the arts. It is not sufficient for them to be able to repeat and to demonstrate a few of the general laws of mechanics, they must be taught the application of the laws. They must be made acquainted with machines.

All honor to the young scholar who foresaw the trend of the times, but his school had a short life. The lyceum existed only about ten years and was discontinued on account of the withdrawal of a legislative appropriation.

The second school, the centenary of which we are gathered here, at this time, to celebrate, was founded in 1824 in Troy, New York, by Stephen Van Rensselaer, of Albany, and was called the Rensselaer School, since changed in name to Rensselaer Polytechnic Institute. Thus was inaugurated the first school, having a continuous existence, to be established in any English-speaking country primarily for the teaching of science and engineering.

The founder was a man of position and education. He was the fifth in direct line of descent from Killian Van Rensselaer, a merchant of Holland who purchased from the Indians, in 1637, a district about twenty-four miles in breadth by forty-eight in length, comprising the territory which has since become the counties of Albany, Columbia and Rensselaer in the state of New York. Stephen, born in 1764, was graduated from Harvard in 1782 and in 1783 took charge of his estates. He became a man of great prominence, experienced in large affairs. He was lieutenant-governor of New York State for six years; a member of the National House of Representatives for three terms; the general in command of the state militia in the war of 1812; a member of two constitutional conventions, of one of which he was president; for twenty-six years a trustee of Williams College; a regent of the University of the State of New York for twenty years and its chancellor during the last four years of his life; a member of the Erie Canal Commission from its creation in 1816, he was its president from 1824 until his death in 1839. As a great landholder he was naturally interested in agriculture, and while in the House of Representatives was chairman of its committee on agriculture. Some years before this time he was elected president of the short-lived Central Board of Agriculture of the state. Although the life of the board was brief, it was long enough to permit a geological and agricultural survey of the counties of Albany and Rensselaer, made under its direction though at the expense of its president. This survey was executed by Professor Amos Eaton and was the first attempt made in this country to collect and arrange geological facts with a direct view to the improvement of agriculture. Analyses of soils were included, as well as a consideration of the proper methods of culture adapted to them, and the results were published in three volumes of transactions. Im-

bued with strong opinions as to the value of such scientific investigations, when the board ceased to exist Stephen Van Rensselaer was unwilling to discontinue work of this character and in the years 1822 and 1823 he caused to be made at his own expense, under the direction of Professor Eaton, a geological survey extending from Boston to Lake Erie, a distance of about five hundred and fifty miles. It embraced a belt fifty miles in width which covered, in this state, the line of the Erie Canal.

The intelligence and benevolence of the founder were now, when he had reached the age of sixty years, to be directed into a new channel. He had long been interested in the instruction of the poorer families of his tenantry and had reached the conclusion that the most valuable education to be given persons engaged in the ordinary occupations of life was one which would enable them to apply the principles of science to the "business of living." His first step in this direction was to engage Professor Eaton to deliver, in various places along the line of the Erie Canal, during the summer of 1824, a series of lectures, accompanied with experiments and illustrations on "chemistry, natural philosophy and natural history." This undertaking was entirely successful. Encouraged by it he determined to establish an institution, the object of which he defined in a letter written from Washington, while he was a congressman, to Rev. Dr. Samuel Blatchford, the school's first president. The letter was dated November 5, 1824. In it he appoints trustees, notifies them that a suitable building has been acquired and funds provided for necessary apparatus, gives rules for the government of the school, and defines his object as follows:

> I have established a school in the north end of Troy, for the purpose of instructing persons who may choose to apply themselves in the *application of science to the common purposes of life. My principal object is to qualify teachers for instructing the sons and daughters of farmers and mechanics,* by lectures or otherwise, in the application of experimental chemistry, philosophy and natural history to agriculture, domestic economy, the arts and manufactures.

His primary object, therefore, was to establish a school of high grade for teachers of science, and in his mind, as his letter shows, the broad field to be covered included *the application of science to nearly every branch of human endeavor.* It will be noticed that the *daughters as well as the sons were to be taught* by these teachers and that domestic economy was one of the subjects in which instruction was to be given.

In his letter the founder appointed Amos Eaton professor of chemistry and experimental philosophy, and lecturer on geology and land surveying. He well knew his man and he appointed no common one to be the first director. Surveyor, chemist, botanist, geologist, author of many works on these subjects, called in after years "the father of American geology," Eaton was above all a born teacher. His reputation was already established. In the catalog of 1826, the first one containing a list of students, of the twenty-five whose names were given, seventeen came from the state of New York and eight from five other states, Vermont, New Hampshire, Massachusetts, Pennsylvania and Ohio. Some of these must have come on foot or on horseback, part of the way at least, to reach Troy. For while there were some canals and some steamboats, there were no railroads and few highways in those days, and it is a great tribute to the reputation of Eaton and of the school, then less than two years old, that students should have come to it so early after its foundation from such distant places. It may be said that since those times students have continued to come from distant places, the records showing that they have come from all the states and territories of the Union and from thirty-eight foreign countries.

While at the beginning the principal object of the founder was to establish a school for the instruction of persons who would disseminate among the people generally information relating to the application of scientific principles to their various occupations, neither the founder nor the management of the institution had in mind the narrowing of its scope or the limiting of its usefulness as a school for teaching the applications of science to the *"business of living."* And so while many of those who had been graduated in the early years afterwards became eminent in various departments of pure and applied science, the renown of the school is principally due to the work of its alumni in the field of engineering—a course in which was soon added to the curriculum.

Some of the principles of certain branches of the science now broadly called civil engineering had been known, of course, since the earliest historical times. Besides various branches of natural science, some of these principles were taught, in this country, in the early founded schools and colleges to which reference already has been made. They were taught, also, in the Military Academy at West Point, which was established in 1802, though it was a school in name only until its reorganization after the war of 1812. On the continent of Europe a number of technical institutions had already been founded, most of which were maintained partly or wholly by the state. The École des Ponts et Chausses was established in France as early as 1747, though it did not become of importance as a school for engineers until a much later period. The Königliche Sächsische Bergakademie was founded in Freiberg in 1765; the École Polytechnic in Paris in

1794; the Polytechnisches Institut in Vienna in 1815, and the Königliches Gewerbe Institut in Berlin in 1821. The latter at the time of its foundation and for twenty-five years thereafter was, as its name indicates, a trade rather than an engineering school. A technical high school was also established in Prague in 1806. The École Centrale des Arts et Manufactures, a private institution, was established in Paris in 1829.

The continental schools of science antedated those of Great Britain. Mention, however, should be made here of Anderson College of the University of Glasgow, founded in 1796 with a bequest of Professor John Anderson, who provided for an institution for the instruction of artisans and others unable to attend the university. In 1799 lectures on mechanics and applied science were begun and these ultimately led to the establishment of mechanics institutes in many towns. But the college never developed into a school of engineering. It was later converted into a medical school. Among the English schools in which scientific instruction was early given may be mentioned University College, established in London in 1828. In the University of London engineering subjects were first taught in 1840. The school of engineering in Dublin University was founded in 1842. Other well-known British schools of science and engineering were established at still later dates.

Although science and some branches of engineering were taught in the early foreign schools, at the time of the foundation of Rensselaer School, there were few engineers, other than military engineers. The term civil in distinction from military engineer had been coined during the last quarter of the eighteenth century, it is believed by Smeaton, but it did not come into general use until the end of the first quarter of the nineteenth century. There had been, of course, inventors and constructors of genius throughout all the ages. Great ruins on more than one continent attest the skill of forgotten engineers. During the Renaissance, Brunelleschi, Michael Angelo and the great Leonardo da Vinci lived and builded and at the later period about which we have been speaking such names as Smeaton and Watt and Fulton come to our minds. But these engineers were born; not made in schools.

There were no schools of engineering in the United States because civil engineering had hardly yet been recognized as a profession. A consideration of the condition of the country and of the state of scientific knowledge as applied to the constructive arts towards the beginning of the nineteenth century shows why this was the case. In comparison with the European states, in which early schools of science above mentioned had been established, the country was new and sparsely settled. Methods of communication were primitive and traveling was expensive. The first canal of considerable length, and these were the first engineering works of great magnitude to be built here, was begun in 1816 and finished in 1825; no steam railroad existed, locomotives not becoming practically successful until about 1830.

Steam navigation was in a more forward state, Fulton's Clermont having made the trip up the Hudson in 1807. In 1815 there were steamboats running between New York and Providence. It was not until 1838 that a transatlantic voyage was made wholly by steam. Steam had however been used for pumping water at a comparatively early date, and there were about seven steam engines in this country at the beginning of the century, although the small amount of power required for manufacturing purposes was obtained from wind and water. During the first quarter of the century many wooden bridges of long span were built, but the era of iron bridges did not begin until 1840. The first tunnel was built in 1831.

The few historical facts above given serve to indicate the condition of engineering science at the period of the school's history we are now considering. Although many of the fundamental principles of applied mechanics were known as well then as now, the development of the science, particularly in its application to structures and machines for the production of useful work, had taken place largely upon empiric lines. Most of the eminent men to whom this development had been due were self taught, were mechanics whose results had been obtained by successive experiments and with little knowledge of the resistance of materials or of the principles of the design of engineering constructions as practiced to-day. And if with these conditions there are taken into consideration the comparative smallness of the population and its extended geographical distribution, the wise forethought and liberality of mind displayed by the authorities of the school in establishing at such an early date a department of civil engineering will be thoroughly appreciated.

An outline of the course of study given in the first catalog, published in 1825, includes land surveying, mensuration, measurements of the velocity of flow of water in rivers and aqueducts, besides mathematics, chemistry, experimental philosophy, astronomy and geology. The catalog of 1826 shows that instruction was given in hydrostatics and hydrodynamics and in calculations upon the application of water power and steam, and in that of 1827 reference is made to land surveying and general engineering. In the catalog of 1828 the duties of Professor Eaton included lectures on civil engineering. This is the first appearance of the term "civil engineering" in any of the catalogs

and no well-defined course in the subject was formulated for several years, though the curriculum of 1831 included elements and applications of civil engineering. In 1835 the trustees created a department "for the purpose of giving instruction in Engineering and Technology" and in the same year the first class in civil engineering was graduated. The course in civil engineering was reorganized in 1849–50 by Director B. Franklin Greene, one of the ablest men ever connected with the faculty. Departments of mechanical and electrical engineering were established in 1907 and that of chemical engineering in 1913.

It will be noticed that this sketch has had reference almost entirely to a few of the early years in the life of the school. Much of interest, even of those days, has had to be omitted. Van Rensselaer's first orders for the government of the institute, the rugged character and original methods of instruction of Amos Eaton, sidelights on the lives of the students, all would be of interest to the historian. Nor have I touched upon the influence of the school upon the development of scientific education and the practice of engineering in this and other countries. These phases of its influence, admittedly great, will be considered to-morrow by Dr. Ray Palmer Baker, distinguished in letters, professor of English in this institution.

Palmer C. Ricketts

AFTER ONE HUNDRED YEARS[1]

We are met to celebrate the hundredth anniversary of the foundation of Rensselaer Polytechnic Institute. It is therefore fitting that we should ask ourselves how far the aspirations of its founders have been justified by its fruits.

To-day the first fruits seem remote indeed. As President Ricketts explained yesterday, Stephen Van Rensselaer proposed to establish in Troy a school for the "sons and daughters of farmers and mechanics." Nominally, therefore, the institute was devoted to the education of both sexes. Actually, it existed for men only. Nevertheless, it exerted a profound and lasting influence upon the colleges and universities which opened their doors to women during the nineteenth century. Before its incorporation, Eaton had conducted courses in botany, zoology, physics and chemistry throughout the eastern states; and not a few of the women who had attended these courses followed him to Troy. One, Mary Lyon, who had been a student in Northampton, became the founder of Mount Holyoke College. Others, also, profited directly by the facilities provided by the authorities of the institute. Naturally, however, its greatest services were rendered by its sons who had been moulded in the spirit of the senior professor. One of them, Eben Norton Horsford ('38), believing, like him, that the failure of women to achieve intellectual distinction was due to lack of opportunity and not to the "perversion of female genius," endowed the laboratories of Wellesley College. Others were active in the state universities. In two at least they were largely responsible for the inclusiveness of which they rightly boast; and in many others they upheld that equality of privilege which we now accept as a matter of course. To the education of women, therefore, Rensselaer made no slight contribution.

Not only was it the first institution to provide—though unofficially—for the scientific education of women, but it was also the first to offer a curriculum in agriculture leading to a degree. Of the interesting features of that curriculum, which it maintained for ten years, I can not speak to-day. Suffice it to say that the young men who enjoyed its advantages established the first state department of agriculture, the first state bureau of entomology and one of the first state experimental stations. The influence of the institute was not limited, however, to governmental departments, bureaus and stations; for in the universities of Alabama, California, Iowa and Wisconsin, as well as in a number of smaller institutions, its alumni served as first professors of the sciences in their relation to agriculture. As in its provision of educational facilities for women, Rensselaer was thus a pathfinder in a field which it has long since abandoned.

Somewhat similar has been the history of its influence upon the academic college. Rensselaer was the first institution to offer the degree of bachelor of arts to students who had completed a course of study in the natural, mental and social sciences. The curriculum leading to this degree—a curriculum embracing mathematics, the sciences, public speaking, literature, rhetoric, composition, government, political economy and philosophy—foreshadowed, in many ways, the type toward which instruction has tended in the last two decades. More significant, however, than this fact, striking as it is, is the theory on which it was based. "Things, not words," was Eaton's motto; and this touchstone he applied to every subject which he professed. As a result of his success, he lived to see the experimental methods which he advocated introduced into many of the colleges which had attacked his proposals. Indeed, before his death he was generally recognized as the originator of field work and laboratory practice in the United States. In themselves these two contributions, rich in result and richer in promise, would almost justify the foundation which we are met to commemorate.

There are other reasons, however, for this celebra-

[1] Address at the centennial celebration of Rensselaer Polytechnic Institute, Saturday, October 4, 1924.

tion. Although Eaton was inclined to challenge the value of the disciplines inherited by the colleges which had scouted his efforts, he soon realized that they were destined to play an essential part in the system which he was attempting to develop; and he was not slow to accept their assistance. As early as 1827 the authorities announced that graduates of recognized colleges and of the United States Military Academy could complete the requirements for a degree in half the usual time. Somewhat later Eaton added that the courses at Rensselaer were intended primarily for those who had completed their academic education; and, in 1832, he asserted that it had become *"the common workshop* for all colleges, academies and other literary and scientific seminaries of learning." What he visualized, therefore, was a graduate school with distinct professional standards; and such a school—the first of its kind—existed in this city for nearly three decades. At times almost half of those enrolled were college graduates—alumni of older institutions, like Amherst, Columbia, Dartmouth, Harvard, Pennsylvania, Princeton, Yale, Union and Williams, represented here to-day. In all, the institute drew in this way upon nearly one hundred centers of higher learning in Europe and America. In the variety of its contributions to educational practice it has not been surpassed.

Nevertheless, in all the enterprises which I have mentioned its achievements were restricted by the years apportioned to them. Indeed, it might almost seem as if its history is a history of lost causes and as if its greatest glory has been due to its renunciations. No such supposition is justified; for each of the developments of which I have spoken—by-products, as it were—bore a definite relation to the ideal which actuated its founders. From the beginning Rensselaer had been devoted to the advancement of science and engineering. In science and engineering it has contributed most to the progress of humanity; and it is because of its primacy in science and engineering that we are met to-day. It is therefore proper that we should attempt to evaluate the fruits of its leadership in these two fields.

I have already stressed Eaton's interest in science. In botany and zoology, physics and chemistry, geology and mineralogy, he was a pioneer; and in all these subjects Rensselaer was a pathfinder.

Of its contributions to botany and zoology I have given you at least an inkling. From the institute came the first text-books in the vernacular. From it came many of the earliest reports, especially those on the flora and fauna of the northwest. Moreover, the young men educated here were the first to establish departments and bureaus for the application of botany and zoology to the needs of agriculture. It is interesting, too, to recall that in a dozen institutions they dealt with them in their relation to medicine as well. Nor, in view of those assembled here to-day, ought we to forget that they not only served such colleges as Middlebury, Rutgers and Williams, but that they also introduced these subjects at such universities as Iowa, Michigan and Wisconsin.

Nevertheless, distinguished as is the record of the institute in the biological sciences, it was terminated at an early period by another shift of emphasis. Only in the physical sciences has it maintained its traditions of achievement. With what it has accomplished since 1885, a date that marks approximately the beginning of a new era in the scholarship of America, I shall not deal. Instead, I shall carry you back to the days when it was still a pioneer, a source of inspiration to the men who laid the foundations of the physical sciences in the universities of the United States. Of the physicists, who have first claim to attention, I can mention only two—De Volson Wood ('57) and Henry Augustus Rowland ('70). In Michigan, Wood instituted the policy of separating the pure and applied sciences which has been adopted by most, or all, of the state universities. At Rensselaer, and later at Johns Hopkins, where he became first professor of his subject, Rowland conducted the researches which gave such a striking impetus to the development of physics during the last fifty years. In the old main building which stood not far from the head of the Approach, he completed his investigations of the maximum magnetization of iron, nickel and steel; and there, too, he formulated the principles governing his classic researches on the magnetic effect of electrostatic charges in motion. To those of us who are entrusted with the advancement of knowledge, it is a sobering reflection that the results of these studies can be compassed by the narrow span of a single generation; for there are not a few here to-day who remember as students the little corner room which Rowland abandoned for his famous "shop" in the city of Baltimore.

In speaking of the contribution of the institute to the development of chemistry, I can not do better than follow the plan which I have adopted in the case of physics. If I had time, I would like to describe the emphasis placed upon the subject in the curriculum. It was this emphasis which made it possible for the alumni to establish departments of chemistry in many institutions of high rank. It was this emphasis, also, which drew them—the first Americans—to the universities of Europe. With the name of one of these adventurers, Eben Norton Horsford, to whom I have previously referred, the campaign now being conducted by Harvard University has made many of you familiar; for it was Horsford, who, as

Rumford professor, induced Abbott Lawrence to establish a school devoted to analytical and practical chemistry in which he conducted the first laboratory courses of any importance given in Cambridge. Of the influence of those courses upon the fortunes of President Eliot, the Massachusetts Institute of Technology and countless other men and institutions you are all aware. The name of another, James Curtis Booth ('31), is also not unknown to some of you. Booth, the most eminent chemist of his day, who founded in Philadelphia the first commercial laboratory devoted to analysis and research, performed for the University of Pennsylvania a service not unlike that rendered by Horsford for Harvard. I might well speak, too, of other men—with no training except that which they received here—who served with no less distinction at smaller institutions such as Rutgers and Williams. Nevertheless, it is to the west that I must turn again in conclusion; for to the great universities like Michigan and Wisconsin they carried the new learning of the school founded by Stephen Van Rensselaer. In the two which I have mentioned, as well as in the universities of Alabama and California, they also led in the application of chemistry to the needs of agriculture. Moreover, in the medical departments of half a dozen universities and a dozen medical colleges, such as Rush and Pennsylvania, they were professors of chemistry in its relation to medicine and sponsors of new and revolutionary methods of analysis and diagnosis.

In geology and mineralogy, of course, Rensselaer was long supreme. From those connected with the institute came the first standard texts—the first, you may be interested to know, in which figures and plates were used to supplement the text—and from them also come the first epoch-making reports. Indeed, approximately half of all the notable developments in these two subjects before 1850 were due to graduates of the institute. They were responsible for the official surveys of Alabama, Delaware, Iowa, New Jersey, New York, North Carolina, South Carolina, Michigan and Wisconsin. In other states their advice and assistance were hardly less useful. Moreover, in a number of colleges and endowed universities as well as in the state universities of Alabama, Iowa, Michigan and Wisconsin, they established a tradition of research which has been honorably maintained by their successors. Among them were many who deserve to be remembered; and yet I must hurry on with a passing reference to two who have special claim to consideration—Ebenezer Emmons ('26), junior professor at the institute and discoverer of the Taconic System, and James Hall ('32), professor of geology and "father of American stratigraphy."

If time served, I would like to speak of other subjects such as astronomy—long stressed at Rensselaer —in which it was able to aid the universities, like Cornell, which were founded after it. In mathematics, also, handmaid of both science and engineering, its graduates were pathfinders at half a dozen institutions. Of necessity, however, I must turn to engineering, a field in which the institute was a pioneer and in which it was long without a rival. In the beginning, however, it did not offer a distinct course in engineering. Not until 1835, as President Ricketts has indicated, was the first class graduated with the degree of civil engineer. Of more immediate result from an educational point of view was the reorganization of 1850 effected by Benjamin Franklin Greene ('42), who became director in 1847. His report is the most significant event in the history of engineering education. It is doubtful whether any other document of similar character has exerted such a profound and far-reaching influence. Aside from local variations in content and method, the scheme formulated by Greene has remained the norm throughout the United States. It is no exaggeration, therefore, to say that by 1850 the essential features of every technical school had appeared at Rensselaer. Nor is it an exaggeration to say that, during the next thirty years, it impressed them, through its alumni or its curricula, upon every institution dedicated to similar aims.

Lafayette and Swarthmore, Cornell and Princeton, Michigan and Minnesota—such are the types—colleges, endowed universities and state institutions—in which the graduates laid the foundations of the departments and colleges of engineering. Columbia and Pennsylvania, Missouri and Texas—such are the types in which they have done valiant service. Nor, above all, ought we to forget the great technical schools—of which Massachusetts and Stevens are symbolic—which drew on Rensselaer not only for some of their first and most eminent professors but also for the curricula which it had evolved. And yet I would lead you astray if I were to suggest that the influence of the institute has been limited to the states of the Union. For a century it has drawn students from other lands, and for a century they have returned to duplicate in them the departments and colleges established by their classmates in the Republic. In Canada they have left their mark on several of the provincial universities. In Mexico, in the countries of Central and South America, in China and in Japan they have also been explorers, carrying the sacred fire from the altars of this modern city with its ancient name to the temples of learning which they have helped to rear. Such is the tradition of achievement which we are met to commemorate.

Though it seems fitting that, on an occasion like

this, we should emphasize the part which the institute has played in the republic of education, we should remember that the majority of its graduates have spent their lives in the world of affairs and that there is no field of activity which they have not made their own. The mechanisms which they have invented; the structures which they have designed; the canals which they have dug; the railroads which they have constructed; the ships which they have launched; the mines which they have sunk; the ores which they have treated; the businesses which they have organized; the industries which they have directed—these, the final fruits of its endeavor, are subjects to which I can not do justice to-day. Emory, Gurley, Riddell, Thacher—figures inseparately associated with the development of exact standards of measurement and calculation! Do I need to remind you, the legatees of their success, of the services which they rendered to their generation? Murphy, Roberts—pioneers in design and manufacture, workers in iron, spanners of floods! Do I need to mention them? Boller, Buck, Cooper, Hodge, Macdonald, Roebling—a brilliant galaxy—craftsmen in steel, conquerors of chasms! Shall I remind you, the inheritors of their traditions, of the achievements which you have so faithfully emulated? Ferris, Shankland—intrepid experimenters in a new architecture! Menocal, Fuertes—explorers, linkers of seas! Evans, Kneass; Cassatt, Crocker; Roberts, Voorhees—trailbreakers and executives whose names are grooved across the continent! Babcock, Mallory; Hopkins, Morse—shapers of ships, masters of men! Pardee, Rothwell; Metcalf, Reeves; Cogswell, Wallace; Lewis, White—spoilers of earth, moulders of metal, generals of organization, conservers of humanity—with their careers I can not deal.

Thou hast sent us forth to labor,
Old Rensselaer.
We have wrought to win thy favor
Year after year.
Steel to wield and stone to shiver,
Sink the mine and span the river,
For thine honor toiling ever,
Old Rensselaer.

This is their story and this is yours—no bleak record of chill materialism but a single-minded devotion to the "common purposes of life" that men may find in them the essence of those higher purposes which are the goal of existence. Such is the ideal which Rensselaer, in every decade, has held before those to whom it has been the mother of learning; and this ideal, realized in the life of its sons, gathered here to do it homage, is not the least of the contributions which it has made to the civilization of America.

RAY PALMER BAKER

TRENDS IN MODERN GEOGRAPHY

GEOGRAPHY formerly was held to be the science which treats of the earth and its people. Considered in this broad sense the field included the subject-matter of many associated sciences, but with little or no correlation. The subject dealt with an infinitude of details; it was scarcely more than a scrap bag into which went a mass of unrelated material. Its methods were almost wholly descriptive; it lacked a unifying principle. Under these conditions it is no wonder that many people conceived the idea that geography was made up of the remains of various subjects and that little interest was manifested in it by the children who were burdened with a mass of facts and with the laborious, thought-deadening reproduction of maps from books.

A significant change has taken place in the scope and content of the subject of geography during the last two decades. For some years before the outbreak of the World War lecturers frequently spoke of the "new geography." The leaders of geographical thought recognized the shortcomings of descriptive geography, of fact geography and of place geography. Emphases were shifting to relational and interpretative geography. Its scope was becoming restricted and concentrated. The subject was defined as dealing with *the influence* of earth features and earth resources on the distribution, character and activities of life—plant, animal and human. This new delineation of the field emphasized the relation of earth features and earth resources to life. However, geographic topics were organized according to a standard outline: (1) Location, (2) area, (3) topography and soils, (4) climate, (5) life forms and (6) human activities. Each section, in most cases, was treated as a unit in itself, and as a result human relationships in the earlier chapters were few. No central theme pervaded these so-called geographic discussions. Moreover, in proceeding from the environment to life responses, geographers frequently assigned to environmental factors a determinant or controlling influence which they do not exert. The whole procedure was characterized by the synthetic rather than the analytic method. Furthermore, this definition called for the relation of the environment to all life, including in the field the subjects of plant and animal ecology. These fields are being developed or cultivated not by geographers but by biologists and zoologists, to whom they rightfully belong. The recognition of this situation and the insistent demands that geography be humanized have led to a clearer statement of the scope and content of the subject.

Geographers in increasing numbers define their subject as dealing solely with the mutual relations between man and his natural environment, physical

and biological. Thus defined, *geography is the science of human ecology.* According to this view, geography is not concerned with the origin and development of land forms, but with the *adjustment* of man to land forms as an element of the natural environment. In like manner, geography as human ecology would not necessitate an explanation of the causes of the different climates of the world, but would involve the distribution of the climatic types and their relations to man as an element of man's environment. Furthermore, geography would not deal with the relations of plants and animals to their physical environment, but with plants and animals as elements of the natural environment affecting men. It must be noted, however, that a knowledge of the principles of physiography, meteorology, climatology and plant and animal ecology are required for a successful portrayal and a clear interpretation of human activities in relation to the environmental features.

As *human ecology,* geography has an organizing concept, a unity otherwise lacking, a point of view unique among the sciences which deal with humanity and a field cultivated but little by any or all of the natural and social sciences. Thus, the subject affords a distinctive field and a controlling viewpoint by means of which its data may be organized with reference to the discovery and application of general truths or principles, the requisites of any science.

VIEWPOINTS AND METHODS OF TEACHING

In addition to evolution in the scope and content of geography, there has been distinct progress in the point of view and methods of teaching. The more significant changes involve (1) the broadening of our outlook from a local one to a world point of view, (2) the presentation of the subject according to natural units and geographic regions instead of political divisions, (3) the cultivation of the center of the field of the subject rather than the marginal portions, (4) the employment of terms better suited to express the relationship of environmental conditions to man, (5) the development of a body of geographic principles, (6) the adaptation of the subject-matter to the child's interest and needs, and (7) the recognition of the usefulness of geographic knowledge in trade and industry.

(1) In pre-war days the currents of trade that supplied our daily needs ran over the earth and the seas so smoothly that we had little interest in their sources or their courses. We experienced no empty sugar bowls, ate no war bread and felt no coal rationing and heatless days. The Great War changed this old order of things. It focused the attention of the whole nation on the war-gripped sections of Europe, on the Far East and even on the remote islands of the Pacific. Our horizon was extended from the borders of a single continent to the distant lands and seas of the earth. It encompassed the needs, struggles and aspirations of the masses of the world. Moreover, the peace deliberations following the war and political moves by various powers since have continued to focus our attention on the factors underlying international relationships and on the problems of new nations carved out of old ones almost overnight. An international viewpoint will continue with us because the United States has come to occupy a central position in the world. This view has permeated the field of geography and will continue to do so in a greater degree. The spirit of the "new geography" is to reach out to all types of people, to study them sympathetically in their natural environment for the purpose of solving their problems and interpreting their ideals and aims in international trade and politics. In addition to this spirit which permeates all grade work, an intensive study of the United States and its international relations is made during the last half of the eighth year's work in many schools.

(2) Years ago, in the study of geography, each state or larger political unit was treated in a detailed manner. Consequently, many facts common to one or more units were repeated for each, without any definite correlation. In contrast to this, the new geography is being taught by increasing numbers by *natural regions* as delineated by some exponents of the subject and by *geographic regions* as set forth by others, thus reducing the repetition of facts and bringing about a scientific organization of the materials and principles of the science. The study of the subject by geographic regions marks a distinct advance, for it is by this method that we can best evolve general truths and principles and apply them, for regional investigations involve facts and principles from all the divisions and subdivisions of systematic geography.

(3) Geography is closely related to history, economics and sociology on the one hand, and to physiography, geology and climatology on the other, yet it has a distinctive field of its own. History, economics and sociology deal with the complex aspects of human activity; physiography, geology and climatology treat of portions of the earth, while geography *is concerned with the relation of human activities to the environment.* It is a science of relationships. From this point of view, it is difficult to determine where we pass from geography into the social sciences; boundaries are indefinite zones and never lines. Therefore, the tendency in productive research is to cultivate the center of the field and to relinquish the marginal portions to the social sciences on the one hand or to natural sciences on the other.

(4) In the development of the subject of geography certain unfortunate terms, as "geographic control," geographic determinant, etc., have been employed by the lay teacher. The tendency among teachers to use language implying that geography in some way acts as a compelling force has caused critics to belittle the teaching of geography. The use of such terms should be avoided; better words express the meaning desired. Nature does not control man; she offers him a choice. Man adapts or adjusts his activities to geographic conditions or responds to the elements of the natural environment. It is wise for geographers to view man's relation to his environment from the standpoint of adjustment to environment rather than from that of environmental influence.

(5) There is a growing tendency in the teaching and in the study of geography to develop a number of clear-cut, general truths or geographic principles. Around these the facts of man's environment and his adjustments in the "new geography" are being organized. The study of geographic facts in order to discover and apply principles, the requisite of any science, offers interesting tasks and affords possibilities for pupils from the lower grades to the university. It promotes industry in the student and helps him to classify his geographic knowledge.

(6) Probably in no other line has progress in the field of the "new geography" been more significant and successful than in the adaptation of the subject to the needs and interests of the child. Home geography occupies a more important place in the school program. Through this medium the children are led to understand the principles of the relation of their local environment to their activities, and with this, as a base, they study, in a sympathetic manner, the environments and activities of distant peoples. They learn what people eat, wear and do, and why they do these things. The subject in the grades increases in difficulty from the home geography to the eighth grade. The new geography in the upper grades in contrast to the old in many cases is not a repetition of the preceding year's work, but a new, live subject appealing to the best efforts of the children.

(7) Modern geography is a new science, and many teachers and most college students know little of its content. They do not realize that the causal element now stressed so strongly has given it a content which has placed geography in the university curriculum and added greatly to its practical value. Business education is taking a new stride in America, and some of our best trained geographers are engaged in fitting men for the larger sphere of commerce. The government now recognizes as never before the value of trained geographers in this field. Map-publishing houses are employing skilled geographers. Large corporations, commission houses and banks recognize the necessity of having trained geographers on their staffs; they have established their own school in order to give adequate training to men in whose charge they wish to place their foreign branches. Skilled geographers are needed to accompany scientific exploring expeditions, and with the increasing need of tropical products the demand will grow. The student who prepares to teach university geography is taking advantage of one of the best opportunities in the entire pedagogical field, and rapid promotion is certain for him if he deserves it. And last, but not least, there is a wonderful service which all teachers of this science can render to humanity by giving our boys and girls through environmental relationships a sympathetic appreciation of why one's neighbor, near or remote, is what he is, and by training them in some of the fundamentals which will make them intelligent and valuable citizens of a great democracy.

Clarence F. Jones
Clark University

SCIENTIFIC EVENTS

THE AMERICAN ASSOCIATION'S COMMITTEE ON THE PLACE OF SCIENCE IN EDUCATION

The American Association for the Advancement of Science is undertaking to carry out a study on the proper place of science subjects in general education, with special reference to American school curricula and to social objectives. This project was authorized by the association council at the third Cincinnati meeting, in December, 1923, and a special committee was authorized to take charge of this important investigation.

Purpose and Support

The committee wishes to formulate an adequately descriptive statement of the purposes and plans now in use in American education and of aims and improvements that seem worthy of serious consideration. This movement has originated from the thought that the unprecedented recent development of the sciences and the rapid introduction of scientific knowledge and scientific thinking into everyday life make it highly desirable that such a statement be formulated, to hasten the spread of a general understanding of the functions of science in modern education. The committee is charged with the responsibility of investigating this whole question and reporting on it at an early time. While the results of this study may not be as definite and as thoroughly based on scientific records, observation and experimentation as would be

ideally desirable, yet it is hoped that a report may be prepared, based on the constructive thought of many competent persons, that may prove very valuable, possibly forming a conspicuous mile-stone in the progress of American education.

Through its director, Dr. Max Farrand, the Commonwealth Fund of New York City has granted to the American Association for the Advancement of Science a fund to aid this work, the money to be used for paying travel expenses incurred by the committee members in attendance at called meetings.

Those interested in science education and in the part that science is playing and will play in American civilization and in our national welfare will cordially welcome the inauguration of this study under the auspices of the American Association for the Advancement of Science.

Existing Reports on American Science in Secondary Schools

In the Report of the Committee of Ten of the National Education Association published in 1893, there appeared definite statements of objectives and lists of recommended science subjects. This report was highly valuable and it served its purpose for a time, but it was eventually superseded in practice and it finally became less than an adequate record of actual accomplishment.

In 1913 a committee of fifty science teachers, under the auspices of the National Bureau of Education, began work on a revision of secondary-school science studies. Its report was published in 1920 as Bulletin 26 of the United States Bureau of Education, and was widely distributed. The purposes, outlines of subjects and sequences of subjects, as presented in that report, were based upon practices then in use in the more advanced school systems. Since the report was issued the types of courses and sequences advocated have become fairly common. Nevertheless, limitation in available time of pupils, in which they may take science, and limitation in availability of teachers with desired preparation, have probably prevented many pupils from securing as much instruction in science or the kinds of instruction thought desirable. Furthermore, the failures of the content, method and organization of science courses to respond to the most pertinent needs of modern social, industrial and esthetic uses is thought to have kept some of the objectives of the report from being as widely realized as was expected.

It seems likely that the report to be prepared by the present American Association for the Advancement of Science committee may deal not only with this problem of elementary and secondary education through school curricula, but also with the problems of science teaching in American colleges, with the social and industrial aims and interpretation of scientific research and with the problem of a proper popularizing and socializing of science knowledge.

The American Association for the Advancement of Science committee requests that all who are interested will make suggestions regarding the plan to be followed in the projected investigation, purposes, means, limitations, worthwhileness, etc., and also regarding men and women who might probably make distinct contributions to the work in hand.

The Special Committee on the Place of Science in Education.

OTIS W. CALDWELL, *Chairman*
425 WEST 123RD STREET,
NEW YORK, N. Y.

THE RICE EXPEDITION TO SOUTH AMERICA

A SUMMARY of the medical activities undertaken by the department of tropical medicine of the Harvard Medical School in connection with the Hamilton Rice expedition to South America during the present year is contained in a statement by Dr. Richard P. Strong, professor of tropical medicine in the medical school, published at the university.

Dr. Strong, who arrived in America a week ago, organized the medical activities of the expedition, having special reference to the investigation of the diseases which prevail in man and animals in the regions traversed. The expedition was organized and conducted by Dr. Hamilton Rice, first, for the purpose of geographical exploration, and second, for medical study and research. The principal geographical object was the study of the sources of the Orinoco River and the physical geography of the country in the vicinity. Dr. Rice is still in Brazil with Dr. George C. Shattuck, assistant professor of tropical medicine of Harvard University, continuing his investigations, and has with him also a trained staff and extensive equipment for making scientific observations.

The other medical members of the party, who returned with Dr. Strong, were, besides Dr. Shattuck, Dr. Joseph Bequaert, instructor in entomology in the department of tropical medicine at Harvard, and Ralph E. Wheeler, of Boston, a third-year Medical School student. Dr. Strong sailed last May to attend the congress of the Royal Institute of Public Health at Bordeaux, the remainder of the party leaving late in June. They brought back with them a large amount of material which will be further studied in the laboratories of the department of tropical medicine at Harvard University. When the study of this material has been completed a scientific report of the results will be published.

The following statement concerning the work is made by Dr. Strong:

The medical studies and investigations which have been carried out on the expedition relate particularly to that portion of the Amazon Valley extending along each side of and parallel to the equator from near the mouth of the Amazon on the east, to the River Branco on the west, a region obviously comprising the greater portion of the most tropical parts of Brazil, and constituting a strip of territory comprised between about 3° 8′ south (Manáos), and approximately 2° 5′ north latitude (Caracaray), and 50° 50′ (Pará) to approximately 64° (Parahiba) longitude west of Greenwich. It is a large plain which with the exception of those portions upon which the cities of Pará and Manáos are located, is almost completely covered with forest, and a great portion of it is semi-inundated. The climate, therefore, as one might expect, is characterized particularly by great heat and moisture, and there are an extraordinarily large number of biting insects many of which transmit disease. The great humidity and continuous high temperature throughout the year render the climate especially debilitating and enervating to those who reside in it, and the population in large areas has been at different times decimated by the infectious diseases which have prevailed.

The prevailing diseases in these regions at the present time are malaria, tropical splenomegaly, chronic ulcerative processes of the skin, leprosy and syphilis. Hookworm disease is also very common, and beriberi, dysentery, typhoid and smallpox are not infrequently seen. Special studies were conducted with respect to the cause and nature of the chronic ulcerative processes of the skin, to the tropical splenomegaly which is so very prevalent, and to the biting insects which prevail, as well as to the infections which occur in the mammals of the forest, some of whom serve as the intermediate hosts of the parasites which cause either human disease or disease in domestic animals. In connection with these studies several species of biting insects, which are probably new, and several animal parasites which have probably been hitherto undescribed, were encountered. Incidentally a number of observations were made on insects injurious to economic plants. In addition a large amount of valuable pathological material for study and for teaching purposes has been obtained.

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGIC EXCURSION

The twentieth annual New England Intercollegiate Geologic Excursion was held in the vicinity of Providence, October 10 and 11. Professor Charles W. Brown, of Brown University, organized the excursion. Dr. Marion D. Weston led one group, Friday afternoon, to McCormick's quarry where fossil ferns and calamites occur in the Seekonk sandstones and conglomerates. A separate excursion was led by Dr. Bradford Willard, the same afternoon, to Lime Rock, a locality famous for its contact metamorphic minerals.

Saturday morning under the guidance of Professor Brown the unconformity between the basal carboniferous and the Milford granite at Neutaconkanut hill, southwest of Providence, was first visited and later a graphite mine at Rocky hill just east of the first locality. The party then motored south to the Sockanossett Mine, where Rhode Island coal is taken out to be sold at $14.00 a ton.

Professor R. M. Brown, of the Rhode Island College of Education, became guide of the party at this point and Gaspee point on Narragansett bay was visited. A study was made of the cuspate bar and folded clays near a submerged cedar swamp excited considerable discussion.

After lunch Professor C. W. Brown again assumed the leadership and an ancient Indian soapstone quarry at Ochee spring was studied. Later the intrusive contact of the Milford granite and the Precambrian quartzites and schists of the Marlboro and Westboro formations was seen at the Manton Avenue quarry. The excursion was brought to an end at the North Burial Ground where an esker of problematic relations was of interest to all.

Thirty-nine persons from ten institutions were present during the two days. The institutions represented were Brown (10), Clark (1), Colby (1), Harvard (8), Massachusetts Institute of Technology (7), Mount Holyoke (3), Rhode Island College of Education (2), United States Geological Survey (1), Wesleyan (3) and Yale (3).

Wilbur G. Foye, *Secretary*

AWARD OF MEDALS BY THE FRANKLIN INSTITUTE

At the stated meeting of the Franklin Institute held on October 15 the following medals were presented: The Louis Edward Levy Medal to Dr. Harvey Fletcher, of the Western Electric Company, New York City, for his paper on "Physical measurements of audition and their bearing on the theory of hearing," printed in the issue of the *Journal of The Franklin Institute* for September, 1923. This is the first award of the Levy Medal, which is awarded annually to the author of a paper of especial merit, published in the journal of the institute, preference being given to one describing the author's theoretical and experimental researches in a subject of fundamental importance.

The Edward Longstreth Medal was presented to Thomas C. McBride, of Philadelphia, for his invention of a locomotive feed water heater.

The Edward Longstreth Medal was also presented to Milton Roy Sheen, of Philadelphia, for his invention of the expansion machine for tunnel construction.

All these awards were made by the institute on recommendation of the committee on science and the arts.

SCIENTIFIC NOTES AND NEWS

A special convocation was held at Lafayette College on October 16 in connection with the exercises to celebrate the centennial anniversary of the college and the completion of fifty years of service there by Dr. Edward Hart, professor emeritus of chemistry, when the degree of doctor of laws was conferred upon Dr. Hart and that of doctor of science upon Dr. Edgar F. Smith, formerly provost of the University of Pennsylvania.

The Bruce medal "for distinguished service to astronomy" was presented to Dr. Arthur Stanley Eddington, Plumian professor of astronomy at Cambridge University, England, by the Astronomical Society of the Pacific on October 17. The presentation was made by President William Wallace Campbell, director of the Lick Observatory. After receiving the medal, Dr. Eddington spoke on the Einstein theory of relativity.

Palmer C. Ricketts, director of the Rensselaer Polytechnic Institute, Troy, has been made a Commander of the Legion of Honor by France. The Italian government recently made Dr. Ricketts a Knight Commander of the Order of the Crown of Italy.

Sir William Bragg, Fullerian professor of chemistry in the Royal Institution, was awarded the honorary degree of D.C.L. by the University of Durham, on the occasion of the opening of the new college of pure science at the university on October 1.

Professor R. Stanziale, of the chair of dermatology at Naples, has been made a chevalier of the Legion of Honor by the French government in tribute to his works presented at the International Congress on Leprosy at Strasbourg last year.

Dr. F. G. Cottrell, director of the fixed nitrogen research laboratory of the U. S. Department of Agriculture, has been elected to be one of the vice-presidents of the American Association for the Advancement of Science and chairman of its chemical section. He will preside at the sessions of the section at the approaching fifth Washington meeting.

Col. Laurence Martin has resigned his position as geographer of the Department of State and has been appointed chief of the division of maps in the Library of Congress.

Walter Goebel, who recently returned from Germany where he has spent a year in graduate work at the University of Munich, has been appointed to the scientific staff of the Rockefeller Institute, New York City, to be engaged in chemical research.

Major James Stevens Simmons, assistant director of laboratories, Army Medical School, Washington, has been appointed associate editor of *Abstracts of Bacteriology*.

Dr. J. L. Ames has resigned as professor of medicine at the Tufts Medical School after 22 years of teaching there.

Dr. Richard Willstatter, who recently resigned his position as professor of chemistry at the University of Munich, has decided not to accept another university position but to carry on his research work privately.

Dr. Carl E. Correns, director of the Kaiser Wilhelm Institute of Biology and professor of botany at the University of Berlin, celebrated his sixtieth birthday on September 19.

Professor Hugo v. Seeliger, director of the Munich observatory and formerly president of the Bavarian Academy of Sciences, celebrated his seventy-fifth birthday on September 23.

Dr. Thorvald Madsen, of the Serum Institute of Denmark and a consultant of the health department of Denmark; Dr. Tryde, of the health department of Denmark; Dr. Fridericia, professor of medicine, University of Copenhagen; Dr. Andreas Diesen, head of the Bureau of Sanitation of the Health Department of Christiania, Norway, arrived in New York on October 10 as guests of the International Health Board of the Rockefeller Foundation.

Frederick G. Clapp, of New York, is engaged in geological explorations in the so-called Kimberley Desert region of northwestern Western Australia.

Donald B. MacMillan, the Arctic explorer, who recently returned from Northern Greenland, intends to devote his attention for some time to northern Labrador. He will probably go north next June on a three months' trip to select a site there for a station for the study of geology, botany and ornithology.

M. Bruneau de Laborie, the French explorer, who last year made a journey from Lake Chad to Egypt, is leaving Algiers in order to cross the Sahara to the Atlantic coast.

Dr. William Snow Miller, professor of anatomy at the University of Wisconsin, will deliver the second Harvey Society Lecture at the New York Academy of Medicine, on October 25. His subject will be "A study of the normal and pathological histology of the lung."

Dr. Archibald Vivian Hill, professor of physiology at University College, London, delivered a lec-

ture on "The ultimate nature of the muscular machine" at the Franklin Institute on October 15.

Dr. Charles Fabry, professor at the Sorbonne and president of the French Physical Society, will deliver a series of twelve lectures at the Massachusetts Institute of Technology on the subject of "Light interference phenomena and their applications." The lectures will be given on Tuesdays and Fridays, beginning on October 13.

Dr. Erwin F. Smith, of the U. S. Department of Agriculture, gave an address in French, on "Cancer of plants," before the Société de Pathologie végétale et d'Entomologie agricole de France, in the amphitheater of the Museum of Comparative Anatomy, Paris, on October 3.

Dr. E. F. Armstrong, retiring president of the Society of Chemical Industry, addressed the regular meeting of the society on October 17 on "The fats from many aspects."

Dr. C. A. Shull, of the University of Chicago, lectured before the Purdue Biological Society at a dinner meeting on October 13, on "The future of plant research in America."

The Harveian Oration before the Royal College of Physicians of London was delivered by Sir Archibald E. Garrod, Regius professor of medicine in the University of Oxford, on October 18.

The life and work of Dr. G. Stanley Hall are to be commemorated at Clark University on Founder's Day, February 1 to 3. On the first day addresses will be delivered by leading alumni of the university and others whose relations with Dr. Hall were intimate. On the second there will be an address concerning Dr. Hall's work as a university president and patron of research. The third part of the commemoration will consist of a brief scientific conference upon genetic psychology.

Professor Edgar Lucien Larkin, director of the Mount Lowe Observatory and lecturer and writer on astronomy, died on October 11 at the age of seventy-seven years.

Dr. Archibald MacLaren, professor of surgery at the University of Minnesota Medical School, chief of staff at St. Luke's Hospital, St. Paul, died on October 13 at the age of sixty-six years.

Dr. Wilhelm Roux, professor emeritus of anatomy, University of Halle, and a pioneer in the study of the mechanics of biology, died on September 15, aged seventy-four years.

Dr. André Bergé, a well-known Paris cardiologist, has recently died at the age of sixty-one years.

The United States Civil Service Commission has announced an examination for junior physicists to be held throughout the country on November 19. It is to fill vacancies in the Bureau of Standards, Department of Commerce, at an entrance salary of $1,860 a year. Advancement in pay may be made without change in assignment up to $2,400 a year.

A Spanish Congress of Medical Science was held at Seville from October 15 to 20, under the presidency of Professor Recasens, of Madrid.

A series of free public lectures on travel and natural history, illustrated by still and moving pictures, will be given at the Field Museum, Chicago, on Saturday afternoons at 3 o'clock during October and November. Dr. William Beebe, author and zoologist; Ernest Thompson Seton, Professor Ira M. Price, of the University of Chicago, and Dr. William Elliot Griffis are among those who will give lectures.

The Tokyo University library, which was destroyed in the earthquake a year ago, is now being restored, a large number of books having been presented by the Rockefeller Foundation, the Universities of Rome, Germany, Michigan, Columbia and California, educational bodies connected with the French Academy and other countries, including India, Australia, Holland and Switzerland.

The *Journal* of the American Medical Association states that the dean of the faculté de médecine of the University of Montpellier, France, has been authorized to accept, in the name of the university, the bequest of 100,000 francs made to the institution by M. J. F. L. Cabanes. This sum is to be used to establish a prize to be awarded the discoverer of a preventive or curative remedy recognized as efficacious for the treatment of tuberculosis. The interest on this sum is to be used every year for one or more prizes to encourage work in the same field.

Mr. and Mrs. Charles S. Fairchild, of Cazenovia, New York, have given to the museum of Colgate University the fossil collection of Ledyard Lincklaen, distinguished in geology and a friend of Professor James Hall.

Specimens from the petrified forest national monument will be given to colleges and museums desiring them, upon payment of the expense of boxing and shipping, according to an announcement made by the National Park Service.

The Pasteur Institute of Kindia Quinea, a branch of the Pasteur Institute in Paris, has recently been organized. Researches can now be made on the anthropoid apes of western Africa, in connection with experimental studies on the transmission and the curability of leprosy, tuberculosis and cancer.

A RESEARCH into the harboring of plague by wild rodents and the specific prophylaxis and therapy of the disease in man, is being undertaken by the South African Institute for Medical Research, Johannesburg. The work is to be carried out largely in a mobile laboratory on the veld. The present staff of the institute is to be augmented by a bacteriologist and an entomologist.

THE first elaborate attempt to preserve the native antelopes that abound in the northwest corner of South Dakota is to be carried out in an area of approximately 15 square miles near the Slim Buttes of Harding County.

AN effort to save from extinction the European buffalo, said to be the rarest living mammal in the world, has begun in Stockholm with the opening of a 100 acre preserve, where these animals will be allowed to live and breed under natural conditions. Out of a total of only fifty-six European buffaloes known to be living at the present time, seven are to be found in Sweden, and up to the present time this herd has been kept in the open air museum of Stockholm.

THE Belgian Colonial authorities are now laying off a large tract of territory in the Kiva district (the gorilla country), and this is to be a sanctuary for gorillas and for all other wild animals. Within these bounds not only the fauna but also the flora will be left undisturbed. Provision has been made for a sufficient number of wardens to prevent the intrusion of hunters and to prevent the destruction of plants or trees. The sanctuary will be a sort of Garden of Eden where the animals may live amid their natural surroundings, without fear of man. This reserve lies in the northeastern part of the Belgian Congo between Lake Kiva and Uganda. It embraces the three volcanoes of Mount Mikeno, Mount Karissimbi (altitude 13,500 feet) and Mount Visoke, comprising an area of about 250 square miles of high and healthy territory, with a variety of temperature varying from the mild climate of the plains to the colder atmosphere of the mountain heights. Here the gorilla may live in peace, and the scientists disarmed may come and study the living animal on his native heath.

FISH planting in the streams and lakes of the national parks is becoming an increasingly important item in park administration, according to the Department of the Interior. During the last year, through the cooperation of the United States Bureau of Fisheries and the Montana State Bureau of Fisheries, 18,635,200 Lock Leven and brook trout fingerlings and black-spotted trout fry and eyed eggs were planted in the lakes and rivers of Yellowstone National Park. Most of the fish-planting operations have been in charge of the Bureau of Fisheries, which maintains a hatchery at Yellowstone Lake, although the planting of nearly 100,000 fingerlings supplied by the Montana State Bureau of Fisheries was done by park rangers.

To observe scientific methods of growing timber crops as developed during the past 15 years in the historic Harvard forest at Petersham, the Northeastern Forest Research Council and a committee of the pulp and paper industry met there on September 4 and 5, according to *Chemical and Metallurgical Engineering*. The Research Council was appointed by Secretary of Agriculture Wallace last winter for the purpose of promoting forest research and of working out more reliable methods of growing timber in the forests of the northeast. The council, which is composed of representatives of all interests concerned with forest research, is acting in an advisory capacity to the Northeast Forest Experiment Station, forest schools, state forestry departments and other forest research agencies in the northeast. The meeting will be devoted primarily to studying the successful forestry operations carried out by Harvard University during about fifteen years of intensive forest management. The conference will also discuss present and proposed forest research programs in the forests of the northeast, the location of substations for the Northeastern Forest Experiment Station, and the Clarke-McNary forestry bill passed by the last session of the congress.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late Mrs. Arabella D. Huntington the Hampton Normal and Agricultural Institute will receive $100,000, the American Museum of Natural History $50,000 and the American Geographical Society $25,000.

MARIETTA COLLEGE, Ohio, has received $50,000 by the will of the late Catherine A. Mather, daughter of the first president of the college.

RADCLIFFE COLLEGE, Cambridge, Mass., has received a bequest of $5,000 through the will of the late Joseph H. Clark, of Boston, the income of which "shall be devoted to the advancement and encouragement of original research in such a manner as to the college shall seem best."

A GIFT of £10,000 has been made to the London School of Medicine for Women by an old student of the school who wishes to remain anonymous.

SIR ROBERT BORDEN, former prime minister of Canada, is to be installed as chancellor of Queen's University at the fall convocation.

DR. JAMES LUKENS MCCONAUGHY, president of Knox College, Galesburg, Illinois, has been elected president of Wesleyan University, Middletown, Connecticut.

JAMES R. WITHROW, professor of chemistry at Ohio State University, has been appointed professor of chemical engineering in the university and will head the new department of chemical engineering which has just been organized.

DR. THOMAS W. TURNER has resigned as professor of botany at Howard University, Washington, D. C., and is now head of the biology department at Hampton Institute, Hampton, Va.

OTTO KOPPIUS, assistant professor of physics at Oberlin College, has accepted an appointment as associate professor at the University of Kentucky.

DR. JOHN PAUL VISSCHER, late Bruce Fellow of Johns Hopkins University and special investigator of the United States Bureau of Fisheries, has been appointed assistant professor of biology in Western Reserve University.

DR. LOUIS LEON THURSTONE has been appointed assistant professor of psychology at the University of Chicago.

DR. A. C. SHEAD, of the University of Illinois, has been appointed assistant professor of chemistry at the University of Oklahoma.

DR. ROBERT DAY WILLIAMS, professor of psychology at Pomona College, has been appointed visiting lecturer on psychology at Harvard University for the first half of the academic year.

DR. H. H. DIXON, professor of botany in the University of Dublin, has been appointed Regius professor of botany in the University of Glasgow in succession to Professor F. O. Bower, who has retired.

DR. FRANK CLARE WILKINSON, of the University of Liverpool, has been appointed to the newly created chair of dental science in the University of Melbourne, Australia.

DR. PAUL SCHRÖDER, professor of psychiatry and neurology at the University of Greifswald, has been appointed professor of psychiatry at the University of Leipzig to take the place of Professor Bumke who has resigned.

DISCUSSION AND CORRESPONDENCE

ON THE RELATIVITY MOTION OF MERCURY

IN a note published in the September fifth number of SCIENCE, Professor Poor seems to have become confused as to the meaning of the gravitational radius (1.47 km) of the sun as used in Einstein's theory of gravitation. This confusion is perhaps due to the fact that Eddington, in his treatment of the subject, takes the velocity of light as unity and is not very explicit as to the physical dimensions of the quantities which he uses. Making no restrictions as to the units employed, Einstein's theory leads to the following equations for a planetary orbit,

$$\frac{d^2u}{d\phi^2}+u=\frac{m_e}{h_e^2}+3m_eu^2, \tag{1}$$

$$r^2\frac{d\phi}{ds}=h_e, \tag{2}$$

whereas Newton's theory gives

$$\frac{d^2u}{d\phi^2}+u=\frac{m_n}{h_n^2}, \tag{3}$$

$$r^2\frac{d\phi}{dt}=h_n, \tag{4}$$

where m_e is the constant obtained by integrating Einstein's field equations and m_n is the gravitational mass of the sun in astronomical units. Moreover ds and dt are related to a sufficiently high degree of approximation by the equation

$$ds=c\ dt$$

where c is the velocity of light.

Comparing (2) and (4) in view of this relation it is clear that

$$h_n=c\ h_c$$

Eddington shows that the second term on the right hand side of (1) is very small compared to the first. So neglecting this term comparison of (1) and (3) gives

$$m_e=\frac{h_e^2}{h_n^2}m_n=\frac{m_n}{c^2}$$

As we are making the gravitational constant unity, Newton's law has the dimensional form $LT^{-2}=m_nL^{-2}$, showing that m_n has the dimensions L^3T^{-2}. Therefore, the gravitational radius m_e is of the dimensions of a length, and does not change from 1.50 km to 13.5 $(10)^{20}$ km according to the choice of units, as Professor Poor would have it do.

LEIGH PAGE

YALE UNIVERSITY

MODIFICATIONS RELATING TO THE "NEW INTERNATIONAL ENCYCLOPAEDIA"

IN a recent number of SCIENCE, Vol. LX (1924), page 82, attention was directed to a very obvious error relating to Copernicus which appears under his name in the 1923 printing of the well and favorably known American encyclopaedia noted in the heading of this article. It should have been stated then that

this error is found also in Volume 9 of the "Biographie Universelle" (Michaud), nouvelle édition, as well as in the "International Cyclopaedia," which was the predecessor of the work under consideration. One might have thought that the biography of such an eminent scientist as Copernicus would not involve such obvious misstatements nearly four hundred years after his death. In fact, the chief interest in this error is due to its persistence notwithstanding its obviousness. It should be added that most of the modern biographical accounts of Copernicus do not involve this error.

A less obvious but more serious error appears in the work under consideration under the term "Descartes rule of signs." It is here stated that "the rule also bears Harriott's name, being given in his 'Artis Analyticae Praxis'." It has been known for a long time that this rule does not appear here and that Leibnitz was responsible for giving currency to this widespread error. In Volume 10 of the "Bibliotheca Mathematica" G. Eneström noted many places where this error may be found. A still more serious error appears under the term "Descartes," where it is stated that he "placed the theory of negative quantities on a satisfactory basis." In this connection it is perhaps sufficient to refer to the fact that in Volume 2 (1921), page 78, of Tropfke's "Geschichte der Elementar-Mathematik" it is stated that the mathematics of the eighteenth century suffered because a satisfactory introduction of negative numbers was then lacking. This was a century after the time of Descartes.

The student who consults this encyclopaedia for the purpose of securing some general knowledge as regards mathematical groups is referred under the word "groups" to the article on "substitution." This would have been a satisfactory procedure seventy years ago, but since that time the general theory of groups has been developed so extensively that the theory of substitutions forms now a relatively small part of this general theory. Hence the broader theory should have been outlined under the term group, while a reference might properly have been added with respect to more special developments under the term substitution. It may be added that in the present article under the latter term one finds the statement that it was a discovery due to Galois "that eventually led to the proof of the insolubility of the quintic." On the contrary, it is well known that this insolubility was established by Abel several years before Galois was old enough to publish new results relating to mathematics even if he began to publish such results at the early age of 17.

It is well known that the first published *formal* algebraic solution of the general cubic and the general biquadratic equations appeared in the "Ars Magna," 1545, written by an Italian mathematician and physician named Cardan. Since complex numbers were not then understood the authors of these formal solutions necessarily failed to understand their generality and could use them only in special cases. In view of these facts one reads in the present work with amazement the following statement under the term "Cardan": "The publication of the 'Ars Magna' stimulated mathematical research and hastened the general solution of biquadratic equations of which Cardan himself solved special cases, as $13x^3 = x^4 + 2x^3 + 2x + 1$; although the credit of producing the first general solution belongs to his pupil Ferrari." This solution by Ferrari is actually found in the "Ars Magna" in question.

In regard to the cubic equation one finds at the same place the following statement: "The solution had been discovered in 1541 by Tartaglia who communicated it to Cardan under the most solemn vows of secrecy." In fact, Cardan himself stated that he made this discovery in 1535, but this is a somewhat minor matter. It is much more important to note that all modern mathematical historians agree that the formal solution of the cubic had been discovered at a considerably earlier date by another Italian mathematician commonly known as Ferro. It is, of course, clear that Ferro could not have fully understood the generality of his results and that he may not have recognized that all forms of the cubic equation can be reduced to the form considered by him. Since this reduction is so very elementary and since we know very little about the work of Ferro such details will probably always remain matters of conjecture or matters of silence, if ignorance implies silence.

While one should not expect to find always in such a general work as accurate statements as are demanded in the special scientific treatises, yet it seems that in many cases a greater degree of accuracy might reasonably be expected. For instance, under the term "cubic equation" it is stated that the roots of the equation $x^3 + px + q = 0$ will all be real when p is negative and $4p^3 > 27q^2$. This inequality implies that a negative number can be greater than a positive number, since it results from the context that q is supposed to be real. Several other inaccuracies which can also be easily corrected appear under the same term and also under the term "series." Since the history of science is mainly an exposition of the compound interest law as regards the development of fundamental concepts it is very important to secure a clear notion with respect to the early development of such concepts.

Under the term "Trigonometry" it is stated that a ratio called *seqt* in the work of Ahmes "seems to correspond to the cosine or the tangent of an angle." The word "tangent" should evidently be replaced here

by cotangent. What is, however, very much more important is that we find here the statement that "Rheticus (1514–76) made a great advance by considering the functions as ratios instead of lines." This is also a very fundamental question relating to the history of elementary mathematics, and the widespread error involved in this quotation was considered by Tropfke in Volume 5, 1923, page 19, of the work noted above in the second paragraph. It is here explained that the modern conception of the trigonometric functions as abstract numbers did not appear before the second half of the eighteenth century, that is, about two hundred years after the death of Rheticus.

In closing we shall refer to one more misleading statement relating to a historical question of fundamental importance. Under the term "Analytic Geometry" it is stated that "the primitive system of coordinates called rectangular coordinates is due to Descartes (Lat. Cartesius) from which fact they are called Cartesian." On the contrary, Descartes did not have a clear notion of such coordinates and some rectangular as well as oblique coordinate systems were used in very early times, especially by the Greeks.[1] They were also used in Europe long before the time of Descartes. In particular, such a system is found in the works of Oresme in the fourteenth century. From what precedes it is clear that in some particulars the popular work under consideration is still in need of much improvement. It is hoped that this discussion may disclose some facts of interest to the general reader and may also have some influence on speeding the needed modifications, which are fortunately made feasible by the frequent printings. In fact, some important corrections resulted from a similar effort made several years ago. *Cf. American Mathematical Monthly*, Volume 24 (1917), page 106.

G. A. Miller
University of Illinois

THE CONTROL OF DAMPING OFF OF COTTON SEEDLINGS BY THE USE OF USPULUN

Owing to the unusually large amount of rainfall prevalent in northwest Arkansas in May and the early part of June, 1924, damping off of cotton seedlings became very prevalent, particularly in those rows where the stand was the thickest and best. As this threatened to destroy some valuable breeding work it was felt that something ought to be tried to effect control, although it was recognized that under field conditions there was very little promise of success.

[1] *Encyclopédie des Sciences Mathématiques*, tome 3, Vol. 3, p. 17.

Accordingly, a 0.25 per cent. solution of Uspulun was prepared, the strength recommended by the manufacturers (Bayer Chemical Company), and the solution applied in a sprinkling can to five rows of cotton. Approximately one gallon of solution was applied to the square foot of soil. Only one application was made. The results obtained are so promising that it seems worth while to present this preliminary report.

At the time of application, the soil was quite moist and the solution was taken up very readily. No particular effort was needed to force the solution into the soil, for there was but little surface drainage. The solution was applied directly over the plants with an ordinary sprinkling can, the application being made slowly so as to enable the soil to take up the solution.

No further damping off has appeared in the five treated rows. In the untreated rows damping off continued to develop to such an extent that large parts of the rows are now bare in contrast to the treated rows on which the stand is much better. A microscopic examination showed that most if not all the damping off was caused by Rhizoctonia. The treated plants have shown no ill effects from the treatment.

H. R. Rosen
University of Arkansas

NOTICE TO ZOOLOGISTS OF GENERIC NAMES TO BE INSERTED IN THE OFFICIAL LIST

The following generic names (with genotype in parentheses) have been submitted to the International Commission on Zoological Nomenclature for inclusion in the Official List of Generic Names.

The secretary will delay final announcement of the votes on these names until January 1, 1925, in order to give to any zoologists who may desire the opportunity to express their opinions.

Mammals: *Alces* Gray, 1821, 307 (*alces*); *Arvicola* Lac., 1799, 10 (*amphibius*); *Ateles* Geoffr., 1806, 262 (*paniscus*); *Bison* H. Smith, 1827, 373 (*bison*); *Bradypus* Linn., 1758a, 34 (*tridactylus*); *Canis* Linn., 1758a, 38 (*familiaris*); *Capra* Linn., 1758a, 68 (*hircus*); *Cebus* Erxl., 1777, 44 (*capucina*); *Cervus* Linn., 1758a, 66 (*elaphus*); *Choloepus* Ill., 1811, 108 (*didactylus*); *Condylura* Ill., 1811, 125 (*cristatus*); *Cricetus* Leske, 1779, 168 (*cricetus*); *Crocidura* Wagl., 1832, 275 (*leucodon*); *Cystophora* Nills., 1820, 382 (*cristata*); *Dasyprocta* Ill., 1811, 93 (*aguti*); *Didelphis* Linn., 1758a, 54 (*marsupialis*); *Erethizon* F. Cuv., 1822, 432 (*dorsata*); *Felis* Linn., 1758a, 41 (*catus*); *Gulo* Pallas, 1780, 25 (*gulo*); *Halichoerus* Nills., 1820, 376 (*grypus*); *Lepus* Linn., 1758a, 57 (*timidus*); *Lynx* Kerr, 1792, 32 (*lynx*); *Mus* Linn.,

1758a, 59 (*musculus*); *Myrmecophaga* Linn., 1758a, 35 (*tridactyla*); *Nasua* Storr, 1780, 35 (*nasua*); *Ovibos* Blainv., 1816, 76 (*moschatus*); *Phyllostomus* Lac., 1799, 16 (*hastatus*); *Procyon* Storr, 1780, 35 (*lotor*); *Putorius* Cuv., 1817, 147 (*putorius*); *Rangifer* H. Smith, 1827, 304 (*tarandus*); *Rhinolophus* Lac., 1799, 15 (*ferrum-equinum*); *Rupicapra* Blainv., 1816, 75 (*rupicapra*); *Sciurus* Linn., 1758a, 63 (*vulgaris*); *Sorex* Linn., 1758a 53 (*araneus*); *Vespertilio* Linn., 1758a 31 (*murinus*).

Amphibia: *Cryptobranchus* Leuck., 1821, 259 (*gigantea* = *alleganiensis* = *alleghaniensis*); *Desmognathus* Baird, 1849, 282 (*fuscus*); *Siren* Linn., 1766, addenda (*lacertina*).

Reptilia: *Alligator* Cuv., 1807, 25 (*mississipiensis*); *Calamaria* Boie, 1827, 236 (*calamaria*); *Chelydra* Schweigg., 1812, 292 (*serpentina*); *Crotalus* Linn., 1758a, 214 (*horridus*); *Dermochelys* Blainv., 1816, 119 (*coriacea*); *Eremias* Wieg., 1834, 9 (*velox*); *Lacerta* Linn., 1758a, 200 (*agilis*); *Mabuya* Fitz., 1826, 23 (*sloanii*); *Phrynosoma* Wieg., 1828, 367 (*orbiculare*).

Pisces: *Blennius* Linn., 1758a, 256 (*ocellaris*); *Echeneis* Linn., 1758a, 260 (*naucrates*); *Esox* Linn., 1758a, 313 (*lucius*); *Ophidion* Linn., 1758a, 259 (*barbatum*).

C. W. Stiles
Secretary to the International Commission on Zoological Nomenclature
Hygienic Laboratory,
Washington, D. C.

SCIENTIFIC BOOKS

The Devonian Crinoids of New York. By Winifred Goldring. Published by the New York State Museum, 1924, John M. Clarke, Director. Memoir 16. One volume, 4to, 483 pp. text, 60 plates, 63 text-figures; with explanation of plates and index, total 670 pp.

The appearance of this superb volume, long expected and long delayed, marks an epoch in American paleontology. It is based primarily upon collections made more than half a century ago under the direction of Professor James Hall by Charles Abiathar White, then a young and impecunious doctor of medicine residing in Burlington, Iowa, who in later years became state geologist of Iowa, and afterwards United States paleontologist. While conducting the first geological survey of Iowa, 1855–1858, on which White was an assistant, Hall noted his great enthusiasm and capacity for field explorations, and when that survey was concluded, took him to New York for the special purpose of collecting the Devonian fossils of that state.

The immediate result was the discovery of a colony of crinoids in the Hamilton shale of western New York near a village now called Vincent, which proved to be, as Dr. Clarke in his historical preface says, "the most extraordinary assemblage of these ancient stone lilies which the rocks of New York, or of the Devonian system, have ever afforded." A distinct crinoidal horizon was located in the Finger Lakes region, in which Dr. White continued his collection during the season of 1860 with phenomenal success, his acquisitions embracing a great number of specimens in exquisite preservation, many of which were new to science.

But little was done in the way of publication of the results of these investigations during the years which followed; but in the meantime many notable additions were made to the Devonian crinoid material from the faunas of the Portage and Chemung groups, chiefly by Dr. Clarke and under his direction. As the result of these various activities, extending over a period of upwards of fifty years, there was accumulated in the State Museum of New York at Albany an unparalleled collection of Devonian crinoids, of such magnitude and variety that nothing short of a special monograph, entirely devoted to the subject, would be adequate for its proper treatment.

The preparation of such a treatise involved a great expenditure of time and labor, for the study of the material and composition of the text, as well as for the execution of the necessary drawings. A large amount of such preparatory work was done by Dr. Clarke with a view to publication, but the pressure of official duties impeded the progress of the work to such an extent that he was at last obliged to look for assistance. To that end an arrangement was made with Dr. Edwin Kirk, then recently graduated from Columbia University, to spend a portion of his time in the study of the problems involved. His subsequent association with the United States Geological Survey, however, was followed by such increasing demands upon his time that the New York work was again subjected to protracted delays.

Finally the revision and completion of the entire theme was committed by Dr. Clarke to his associate, Winifred Goldring, who after several years of devoted study brought the work to a conclusion ready for publication. Here again another long period of delay ensued before the printing of the volume could be accomplished, so that while Dr. Clarke's historical preface to the completed work is dated in 1919, it was not until 1924 that the actual publication and distribution could be secured. Some compensation for the vexatious procrastination, however, may be found in the quality of the printing, which has been done in a manner unsurpassed by any scientific publication produced in this country. In point of typography, paper and general execution of the work, there is nothing finer in American paleontology, and the authorities

of the state of New York are entitled to the utmost credit for having provided the means for publication of a fine contribution to science in so admirable a manner.

As explained in the director's preface:

> The present book is Winifred Goldring's work. She has revised and rewritten all previous manuscripts; has compiled and checked up outstanding references; has corrected the old drawings and supervised the making of many others; has had the advantage of certain new materials which others who have touched the work did not have; and her work has been done not only conscientiously and with assiduity, but with reasonable completeness, and with credit to the paleontology of New York.

To this estimate of the value of the author's work, as evidenced by this great monograph, the present writer is glad to add his own testimonial, after a careful perusal of the volume. The many perplexing problems which arose have been handled with a maturity of judgment and depth of research that would do credit to an author of longer experience, and while producing a work that will be an honor to the state, Miss Goldring has erected an enduring monument to her own industry and zeal in the field of pure science.

The technical portion of the monograph is preceded by a popular account of the crinoids as a class, their structure, ontogeny and mode of occurrence, with special reference to those of New York, which should be most useful for the students of paleontology in the schools and institutions of the state. There are also convenient references to the literature pertinent to the subject, together with lists of the genera and species occurring in the Devonian formations, and of the localities in which they are found. The species listed, described and figured number 157, belonging to 60 genera. Of these 18 genera and 57 species are new to science, and therefore are now described and illustrated for the first time. The fine illustrations which adorn the 60 quarto plates are from the skilful brush of Mr. George Barkentin, of the State Museum staff, whose work is well known from previous publications. The figures on the plates are most usefully supplemented by the numerous text-figures interspersed throughout the descriptive matter, prepared by the author, especially the generic diagrams, which aid materially in the understanding of the new forms.

Space does not admit of extended discussion of details, in which many interesting points are brought out bearing upon structure and classification, such, for example, as the presence upon the arms of some crinoids of two or more pinnules to a single brachial, which is observed in three genera in addition to three previously known. The arrangement of the matter in the book, together with the tables and lists replete with serviceable information, and the full general index, furnish the means of convenient reference to any desired fact, which will be most welcome to paleontologists and students who have occasion to consult the work, as well as to geologists engaged in the intensive study of the stratigraphy of New York.

FRANK SPRINGER
SMITHSONIAN INSTITUTION

The Ants of Timothy Thümmel. By ARPAD FERENCZY. Jonathan Cape, Ltd., London, 1924. Price 7/6 net.

To the biologist in search of literary recreation the perusal of Professor Ferenczy's Gulliverean tale is recommended. His fantasy possesses the unusual distinction of being based on fact, to prove which an extensive bibliography, compiled with the assistance of our distinguished myrmecologist, Mr. Horace Donisthorpe, and Miss L. E. Cheesman, is appended. The story is based on the discovery of Dr. Timothy Thümmel that certain curious yellow spots on dry laurel leaves from a huge ant's nest in Central Africa represented a myrmecine attempt to bequeath to posterity the history of their race. Dr. Thümmel's "discovery" brought to its originator the inevitable result of all such discoveries: he was confined in a lunatic asylum, where he died by his own hand in 1916. And so it has been left to Professor Ferenczy to administer his literary estate—the deciphered Elm-Ant-Foot-Hieroglyphics or the Aruwimi Ant Chronicles, a brilliant travesty of human life and shortcomings. The laurel leaves were collected by Professor Ixli of Elm in the late nineties and were obtained by Thümmel through the professor's grandson. The series was unfortunately not quite complete as some of the leaves had been used by the ladies of the Elm household to add a taste to their master's favorite dish of lentil porridge!

The book opens with an account of the ant-creation. As in the Biblical story, the ant Adam and Eve (known as Mye-Mye and Nye-Nye, respectively) were created in her own image by a legendary Giant-Ant, who granted to her first subjects, among other things, the right to enter her kingdom after death, to live in her glorious presence a life of Olympic happiness "from everlasting to everlasting." Many millions of ant-generations later this tradition of the myrmecine origin was rejected as mere superstition, as the fable of our own first parents has now been assigned to the limbo of cherished beliefs. According to Mye-Mye, the road to everlasting happiness after death lay in ceaseless labor, but eons later, in the reign of the then king Tye-Kye of the Tye nation, a revolution, headed by his indolent but clever subject Kye-Kye, broke out against the ancient teaching. Kye-Kye claimed that the omnipotent Giant-Ant, whose name he said was Pye-Vye-Nye, had revealed to him that all ants must henceforth cease work and adore her

holy name under penalty of being plunged into utter darkness and in an abode of filth being turned into sheer dung beetles! Knowing, however, that a complete cessation of work must mean utter destruction, the crafty Kye-Kye, after another interview with the Ant-Mother, said that she had given him permission to represent the people, and so with a few others he formed the band of Holy Ants or Fat Bellies, which were fed and cared for by their less sacred brethren. This example was followed by the other ant-nations of the Aruwimi glade, each giving their giant-ant a particular name and laboring under the delusion that theirs was the only true Ant-Mother. As with man, so with these ants was God created in their own image. The adoption of religion, the supposed panacea of all ills, led to various holy wars which resulted in the increased power of the monarchy and their warriors. These warrior-ants desired the same life of ease as their holy brethren and formed a sect known as the Robber or Lord Ants, or more vulgarly as Big Heads. They were responsible for the despicable institution of slavery to ensure their life of luxury and ease.

Professor Ferenczy goes on to relate how the daughter of King Tye-Kye, the beautiful Tye-Nye, eloped with an ant of another nation (Hye-Hye of Hye) and of the war which resulted between the two nations. Other interesting chapters in his book (which space does not permit us to review in detail) are those dealing with the Holy Fat-Belly, Kye-Lye, who learned to write with his feet and was regarded as insane by his brothers, of the Aruwimi ants' love for the intoxicating juice of the Sacred Berry, of their marvelous systems of agriculture and weaving, of their living honey-pots, and of the betrayal of the lies of their ancestors by the Holy Kye-Pszye and the Big Head Pye-Kszye. His story reaches its climax with an account of the great Ant-World War and the eventual restoration of the laws of Mye-Mye, the great and universal truth of which reads, "The only clear title to life is Labor;" and so the ants returned to their primitive habits. Will man follow them?

Dr. Thümmel believes that the ants are at least three times as wise as us "stupid, God-forsaken, two-legged protégés of Prometheus," but his work itself belies this statement. In closing the covers of a delightful book we are compelled to agree, in two-legged arrogance, with Mr. Julian Huxley:

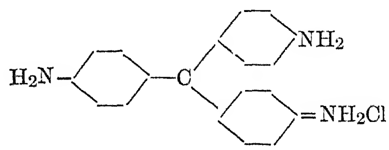
> The Ant herself can not philosophize—
> While Man does that, ...
> And flies, and talks and is extremely wise.

CEDRIC DOVER

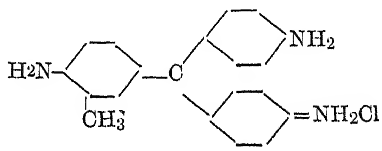
LONDON

A REPORT ON BASIC FUCHSIN

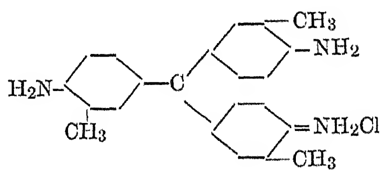
WHEN the Commission on Standardization of Biological Stains undertook the investigation of basic fuchsin, looking toward its certification, certain problems were discovered that had to be solved before definite specifications for this stain could be drawn up. There are three different compounds present to a different extent in grades of basic fuchsin. These three compounds differ from each other in the number of methyl groups they contain. The simplest of these is pararosanilin, which has the formula:



This same compound with one methyl group introduced becomes rosanilin:



With three methyl groups it becomes new fuchsin:



There are three recognized textile dyes composed of these three compounds. The first of these (which is given the number 676 in the Colour Index) is essentially pararosanilin. It is sometimes called basic fuchsin, but should probably be called basic rubin. The second (Colour Index No. 677) is a mixture of rosanilin and pararosanilin in about equal parts; it is the basic fuchsin of commerce. The third is trimethyl fuchsin, and has the Colour Index No. 678; it is known in the trade as new fuchsin. It was discovered that different stain manufacturers are supplying biologists with different compounds in this group under the name of basic fuchsin.

There are two chief purposes for which basic fuchsin is used, first for bacteriological staining (especially for the tubercle organism) and secondly for use in the Endo medium for the detection of the typhoid organism. Some manufacturers put out a special product for each of these two purposes. Others claim that theirs will do for both purposes. In the absence of authoritative information on this subject an investigation seemed to be called for.

In the course of this investigation eleven different

samples of basic fuchsin were submitted to examination. Five of them proved to be fairly pure pararosanilin, five of them new fuchsin, and the eleventh sample apparently a rosanilin almost entirely free from pararosanilin and hence different from any of the ordinary fuchsins of commerce.

The results of the investigation showed quite plainly that, although pararosanilin is ordinarily satisfactory as a bacteriological stain and for other staining purposes, it is not usually satisfactory in the Endo medium. One sample was found which gave good results when used for the latter purpose, but just why it proved better than the others has not been learned. The best sample for all purposes, as judged by the five reports received from different investigators, was the sample of rosanilin without pararosanilin. Almost equally good, however, were some of the samples of new fuchsin. Accordingly the following specifications are now drawn up to apply to basic fuchsin:

(1) Basic fuchsin designed for staining and indicator purposes must be rosanilin or new fuchsin (Colour Index No. 678) or else a mixture of rosanilin and pararosanilin containing at least half of the former (that is corresponding to Colour Index No. 677).

(2) Fuchsin samples to be certified by the commission must be of such a strength that, when reduced by titanous chloride in an atmosphere of carbon dioxide, one gram of the dye will consume at least 46.5 cc normal titanous chloride solution. A sample of this strength will be between 76 and 85 per cent. total dye content, the exact dye content varying according to the relative amounts of the higher and the lower homologs present.

(3) The sample should prove satisfactory for staining the tubercle organism and should retain its color sufficiently when treated by the Ziehl method to be diagnostic when staining tubercular discharges. This must be determined by an investigator skilled in this particular technic.

(4). The sample must prove satisfactory for use in the Endo medium. In making this test the following technic should be used: A saturated alcoholic solution is diluted 10 to 30 times, the dilution to be such that no precipitation occurs when mixed with a sodium sulphite solution. Then add 0.5 cc of this dilute fuchsin solution to 10 cc of a 2.5 per cent. sodium sulphite solution. Add it to the other ingredients of Endo agar, sterilize and cool. It should then be colorless, but the color must be restored by the colon and dysentery organisms when inoculated upon it. The test must be made by one familiar with the technic in question.

(5) It must be understood that as basic fuchsin is used in other special forms of technic, new standards may be called for. The present specifications apply particularly to the above mentioned two uses; but samples fulfilling them are ordinarily satisfactory for all histological purposes.

At the present time permission to use the commission's label on batches of basic fuchsin submitted has been given to three companies. Some of the batches submitted are recommended as satisfactory for general staining purposes and for use in the Endo medium. Others have been approved for one or the other of these two purposes only. The three companies in question are the Empire Biochemical Company, the Hartman-Leddon Company, and the National Aniline and Chemical Company. The certified samples of fuchsin do not have to be bought from these three concerns directly, but can be obtained through dealers in biological supplies. It is recommended that any one desiring fuchsin of this quality order it from some dealer, specifying the basic fuchsin certified by the Commission for either one or both of the above-mentioned purposes, according to the needs of the particular purchaser.

H. J. CONN,
Chairman, Commission on Standardization of Biological Stains
GENEVA, N. Y.

SPECIAL ARTICLES

SERIES IN THE SPECTRA OF ALUMINUM AND MAGNESIUM IN THE EXTREME ULTRA-VIOLET

PASCHEN (Ann. d. Phy., 71, p. 152, 1923) in his investigation of the spectrum of doubly ionized aluminum (Al. III) and Fowler (Series in Line Spectra, p. 120) in his study of ionized magnesium (Mg. II) have pointed out the type of series relations which exist in these substances, and have arranged many lines to conform to them. In a study of the spectra of both aluminum and magnesium in the extreme ultra-violet under various forms of excitation, I have recently observed certain lines which appear to be higher members of some of the series discovered by Paschen and by Fowler; Millikan has already identified the two strongest but the remainder seem to have escaped observation. The wave lengths and the series to which these lines belong are given in the following tables.

The lines in aluminum were obtained with the vacuum spark and also with a condenser discharge in an atmosphere of helium at about a millimeter pressure. The magnesium lines were most strongly excited by an arc of 40 volts and about ten amperes operated in a high vacuum by means of a trembler device.

The numerical values of the wave lengths should be correct to at least two tenths of a unit.

Al. III

3p.—md.				3p.—ms.				3s.—mp.			
Obs.		Calc.		Obs.		Calc.		Obs.		Calc.	
λ	Int.	λ	m	λ	Int.	λ	m	λ	Int.	λ	m
891.9	(1)	892.0	4	855.0	(3)	855.02	5			695.8	4
893.8	(2)	893.9		856.7	(4)	856.76		696.0	(6)	696.2	
				725.7	(1)	725.6	6			560.3	5
				726.7	(2)	726.8		560.3	(3)	560.4	
								511.1	(1)	511.2	6

Mg. II
$1\sigma — m\pi$

Obs.		Calc.	
λ	Int.	λ	m
1240.1	(4)	1239.9	2
1240.5	(4)	1240.4	
		1026.0	3
1025.9	(2)	1026.1	
946.6	(1)	946.7	4

It must be admitted that both Millikan and Simeon list a line at λ 560.5 which they credit to carbon. The line at 1025.9 in magnesium might perhaps be ascribed to hydrogen were it not for the extreme weakness of the hydrogen line at λ 1216.

The persistence of impurities, especially when high voltage excitation is employed, introduces uncertainties which can not well be eradicated. But in my judgment, the structure of the spectrum and the close agreement between observed and calculated values justifies the identification shown in the tables.

Theodore Lyman
Jefferson Laboratory,
Harvard University

LICE FROM HUMAN MUMMIES

For a very long period of time there has been discussion as to whether or not each of the different primary races of mankind harbored a distinct race of lice, particularly head lice. Confusion has followed controversy in this matter until to-day we find that there is no semblance of accord in regard to the problem. If one studies a large series of lice from living Americans it is observed that apparently there is no correlation between louse types represented and the racial types of the host individuals. It was while studying such a series that the writer became convinced that he was dealing largely with hybrids of different racial types or varieties of lice. This conviction deepened greatly when it was learned from the results of Bacot's work during the world war that the head louse of man would hybridize with the body louse and give fertile progeny.

Knowing that these two louse varieties hybridize and that there has long been an intermingling of three of the primary races of men in this continent, the writer conceived the idea of going back to prehistoric man, before the mixing of these races took place, and examining scalps of mummies in order to get samples of unhybridized lice.

Scalps of precolumbian Peruvian mummies in the Department of Anthropology of the United States National Museum were first examined. Six of these were obtained and five of them were found to be well laden with nits; unfortunately, however, no adult lice were secured. Nits also were found on an Egyptian mummy, but of the fourth century A. D. Later, through the courtesy of Dr. Frank E. Lutz, of the American Museum of Natural History, a loan was secured of scalps or hair samples from no less than twenty prehistoric American Indian mummies from that institution. All these were examined. Ten were found to possess nits; and of these ten, three also had lice, one being laden with dead lice of all stages of development.

It is not the intention of the writer of this communication to discuss here the taxonomy of these mummied lice, but he would like to record the fact that those from Peruvian mummies are slightly different from those of mummies taken in southwestern United States, and also that all the lice from prehistoric mummies show differences from some lice obtained from a living Indian. It is of course probable that our living Indians in some instances not only have the Caucasian head louse but also the Ethiopian type and possibly hybrids between these two or between the American type or types and either the Caucasian or Ethiopian type.

The American mummy type of head louse is quite distinct from what Fahrenholz describes as *Pediculus humanus marginatus,* a Japanese variety. It is much nearer what he describes as *Pediculus humanus chinensis,* the Chinese head louse. It should be stated, however, that the writer has never seen either the Japanese or Chinese type of head louse and also that he is inclined to doubt the advisability of recognizing more than one variety of louse for the yellow race of mankind.

A comparison of these mummy lice with *Pediculus* lice from American monkeys of the genus *Ateles* has been made. It should here be recalled that by many authorities the Pediculid lice of our American monkeys are considered as being only the common head louse of man. In the writer's investigation it was

found that these lice from mummies were quite distinct from the monkey-infesting forms. In fact, the writer has discovered that all these monkey Pediculids of America can be distinguished from any of the varieties of our head louse by the characters of the pleural plates. If the pleural plates of the man-infesting forms are viewed from the side they are found to be squarish and without lateral lobes. Now if the pleural plates of any of the *Ateles*-infesting forms are viewed from the side they are found variously shaped but not squarish, and in addition some of them are provided with well-developed lateral lobes.

It may be that the spider monkeys (*Ateles*) acquired their Pediculids originally from man but not from recent man. The time must have been thousands of years ago, more probably tens of thousands of years ago, for there are at least two or three quite distinct species of lice on *Ateles*.

Kellogg (SCIENCE, Vol. xxxviii, p. 601) attaches much phylogenetic significance to the occurrence of *Pediculus* species on *Ateles,* holding that it indicates that these monkey hosts represent American derivatives of the Old World anthropoids. It is possible in this case, however, that there has been a crossing-over, *i.e.,* that the *Ateles* lice have been derived from some of the near ancestral types of recent man or that the whole human complex of lice is of a more recent derivation and from certain unrelated monkey hosts. That lice may cross over from hosts of one phylogenetic group to those of a different phylogenetic group, "bridging the phylogenetic gap," the writer has pointed out in the case of the biting lice of the family Gyropidae. The lice of this family apparently have crossed over from their ancient and most favored hosts, certain rodents, to their more recent and less favored hosts, ungulates and primates.

It may be, however, that in *Pediculus* we are dealing with one of those generalized types that refuses to respond in the usual manner to the diversifications of the environments into which the group has thrust itself. In other words, it has become to an unusual degree more or less independent of the minor charges of environmental conditions. In this connection I would like to record here the infestation of two brown-hipped marmosets (*Lenotocebus nigricollis*) with a *Pediculus* species. There is strong evidence in these two cases, however, that the lice were stragglers from the badly infested *Ateles* species, yet many eggs were laid on both marmoset hosts by the lice. These infested marmosets were brought back from South America for the National Zoological Park by W. M. Mann in 1922.

H. E. EWING

BUREAU OF ENTOMOLOGY

DECOMPOSITION OF CERTAIN ORGANIC TOXINS BY VANILLIN DECOMPOSING ORGANISMS[1]

HAVING found bacteria in many soils able to decompose certain toxins the question arose as to whether the same or different organisms of a given soil decompose the several toxins.

In order to answer this question, pure cultures of organisms able to decompose vanillin were isolated from several soils and used to inoculate a medium containing another toxin. Fifty cubic centimeters of medium were placed in each of several Erlenmeyer flasks as usual, and inoculation was made in duplicate for each organism. These cultures were then incubated at room temperature for about 10 days. The results obtained with vanillin (control) resorcinol, cumarin, quinoline, benzidine and caffein follow:

Organism	Growth a	Growth b	Toxin present a	Toxin present b
Vanillin toxin medium				
Vanillin 5a2	yes	yes	no	no
Vanillin 21a	yes	yes	no	no
Vanillin 22a1	yes	yes	no	no
Vanillin 130–1	yes	yes	no	no
Control	no	no	yes	yes
Resorcinol toxin medium				
Vanillin 5a2	no	no	yes	yes
Vanillin 21a	no	no	yes	yes
Vanillin 22a1	no	no	yes	yes
Vanillin 130–1	no	no	yes	yes
Control	no	no	yes	yes

In neither of the duplicate cultures of organisms of any of the four soils was cumarin, quinoline, benzidine or caffein decomposed. The results were negative as in the resorcinol cultures detailed just above. From these results it appears that these vanillin decomposing organisms are not able to decompose any of the five toxins tested—resorcinol, cumarin, quinoline, benzidine and caffein—under the rather favorable conditions of the tests and that they are able to decompose vanillin only.

In spite of the strong indications mentioned above there is some doubt of the specificity of these organisms, since it is not known whether they had ever decomposed vanillin before being brought into the laboratory for these experiments. Moreover, this must for the present remain an uncertainty because the samples were too small to analyze for vanillin.

It is highly desirable that this study be extended to other toxins, and also that organisms which decompose other toxins be tested for their ability to decompose vanillin and still other toxins.

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[1] Published with the permission of the director of the Alabama Experiment Station.

SCIENCE

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CONTENTS

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PRELIMINARY MEASUREMENT OF THE VELOCITY OF LIGHT[1]

THE velocity of light is one of the most fundamental of the constants of nature, and this alone would justify the attempt to measure its value with the highest possible precision. But in addition to its scientific importance it may prove to have a practical value if the result of such a measurement can be obtained with sufficient accuracy.

The mean of the various measurements thus far attempted is 186,330 miles per second, with an uncertainty of 20 or 30 miles. If this uncertainty can be reduced to one mile, the result could be utilized to obtain distances between stations from 50 to 100 miles apart far more expeditiously and with an order of accuracy at least as great as that obtainable by the usual method of triangulation. Indeed, there are possibilities of utilizing the velocity of light in cases where triangulation would be difficult or impossible.

An invitation tendered by Dr. G. E. Hale, then director of the Mt. Wilson Observatory, and supported by Dr. J. C. Merriam, director of the Carnegie Institution, made it possible to install the necessary apparatus on Mt. Wilson, with Mt. San Antonio 22 miles away as the distant station, during the summer of 1923; but smoke and haze from burning oil and from forest fires made it impossible even to test the feasibility of the method at so great a distance.

This was accomplished during the past summer with very promising results. The set-up of apparatus involved several important changes in the arrangement employed in previous investigations, the most important of these consisting in the substitution of an octagonal revolving mirror instead of a plane-parallel, together with a system of reflectors which eliminated all direct and diffuse extraneous light. Finally, a simple method for returning the light from the distant station back to the source was substituted for the plane mirror used for this purpose in previous work, and this functioned so well that no readjustment was required during the entire two months of the work.

The advantage of the octagonal revolving mirror, in addition to the higher speed obtainable, lies in the possibility of receiving the return light on a succeeding face, thus eliminating the measurement of the angular deflection of the returned beam; or rather

[1] Presented at the Centenary Celebration of the Franklin Institute, Philadelphia, September 17–19, 1924.

transferring this measurement to the construction of the octagon, the angles of which were tested and found to be equal with an uncertainty of only one part in a million.

The determination of the velocity of light is thus reduced to the measurement of the distance between the stations and of the speed of rotation of the mirror. The former operation was carried out by the U. S. Coast and Geodetic Survey with the result 35,426.3 meters (about 22 miles) with an uncertainty of the order only two parts in a million.

The errors in the measurement of the speed of the revolving mirror were much greater, as no very effective means were employed to insure its constancy. (This defect will be eliminated in the continuation of the work next summer.)

Notwithstanding the inconstancy of the speed of the mirror, by choosing the most favorable moment, when the speed was that corresponding to the frequency of a control tuning fork, the resulting uncertainty of the measurements was of the order of one ten thousandth part, which is about that of the mean of all the previous measurements.

It is hoped that next year's work will furnish results four or five times more accurate.

The result of eight independent observations in the present preliminary work is, for the velocity of light in vacuo, 299,820 kilometers per second.

Following is a table of results of the more important investigations to date with an estimate of the weight which should be assigned to each:

Investigator	Method	Distance	Wt.	Velocity
Cornu	Toothed Wheel	23.0 Kilom.	1	299950
Perrotin	" "	12.0 "	1	299900
Michelson	Revolving Mirror	0.6 "	2	299895
Newcomb	" "	6.5 "	3	299860
Michelson	" "	35.4 "	3	299820

A. A. MICHELSON

UNIVERSITY OF CHICAGO

A NEW TYPE OF ELECTRIC DISCHARGE: THE STREAMER DISCHARGE[1]

IN connection with a detailed study of the mechanism of electric discharges in argon we have observed some phenomena of remarkable beauty which may prove to be of theoretical interest.

A single loop tungsten filament of large diameter (0.5 mm) is mounted at one end of a cylindrical pyrex glass bulb 10 cm in diameter and 15 cm long with its axis horizontal. Rising vertically from this bulb is a tube 3 cm in diameter and 50 cm long which contains at its upper end a disk shaped anode. The tube is exhausted for an hour at 450° C., and the electrodes are freed from gas by induction heating and the tube is filled with extremely pure argon at a pressure of preferably 2 to 4 mm of Hg. The cathode is heated to about 2500° K and + 250 volts is applied to the anode through a resistance. By approaching one terminal of a high frequency coil to the middle of the glass tube an arc of about one ampere is started through the tube, and the voltage difference between anode and cathode falls to about 25 volts.

The arc then fills the tube with a uniform pale reddish glow showing only lines of the red argon spectrum. A transverse magnetic field, from a hand horseshoe magnet with poles 4 cm apart, has practically no effect on the appearance of the arc.

The *streamer discharge* may now be started by opening the cathode heating circuit for *one half second,* allowing the current to return immediately to its former value. This lowers the cathode temperature momentarily and by decreasing the electron emission causes the voltage across the arc to rise from 25 to 100 volts or more for perhaps a second. The cathode drop sputters tungsten from the cathode in an amount which is estimated to lie between 10^{-6} and 10^{-7} grams.

This small dose of tungsten vapor has a profound effect on the arc. There are at first brilliant blue flashes of light from the lower end of the tube which show the tungsten spark spectrum. Simultaneously the arc begins to detach itself from the glass walls, starting at the lower end and gradually, in 5 to 15 seconds, extending up to the anode.

After 30 seconds or so the blue tungsten spectrum disappears and the arc quiets down but remains detached from the walls for its entire length. At first the arc is 1 to 1.5 cm in diameter and is bounded by a sharply defined luminous skin which emits a dull yellow light showing a continuous spectrum. The interior of the arc is reddish (argon spectrum), but is separated from the yellow skin by a dark space 1 or 2 mm thick.

Sometimes just inside this dark region there is a transient bluish white skin of considerable brilliancy which seems to show a mixture of continuous spectrum with the tungsten spectrum.

After perhaps 1 minute the yellow skin has disappeared and the arc has increased so much in cross-section that it seems at first as if it had returned to its original condition.

[1] Abstract of an address by Irving Langmuir at the Centenary of the Franklin Institute, Philadelphia, September 18, 1924.

The arc, however, is now very sensitive to even weak magnetic fields. On bringing the horseshoe magnet within 10 to 15 cm of the tube, so as to produce a transverse field, the arc is deflected to one side of the tube in the same direction as any conductor carrying a similar current. Thus the arc is pushed up against the wall of the tube and at the same time the *yellow skin* reappears on the opposite side of the arc, that is on the side which is not in contact with the wall of the tube.

Upon bringing the magnet still closer the yellow skin becomes more brilliant and thinner, and then begins in a remarkable way to exhibit many of the characteristics of a liquid surface. In fact the appearance is strikingly similar to that of the surface of water dripping from the under side of a horizontal wet board. Little droplets of golden yellow liquid fire form slowly, move irregularly parallel to the direction of the surface and then break away and fall, as little spheres of light, in a direction perpendicular to the surface (into the arc). By regulating the intensity of the magnetic field these droplets, or globules, ranging from a few tenths mm up to 5 or 6 mm in diameter, can be made to form slowly and detach themselves singly from the skin of the arc. They usually move all the way across the arc and disappear when they reach the opposite boundary close to the glass wall. But by proper combinations of longitudinal and transverse field the globules may often be made to move upwards or downwards in the arc parallel to its axis for distances of 5–10 cm. The light emitted by the globules is nearly white and is enormously more brilliant than that from the yellow skin of the arc.

Under certain conditions the globules have been observed to move very slowly so that their motions through the arc could be easily followed by the unaided eye. But more often they move at velocities of 10 to 30 cm per second and thus appear as brilliant lines or filamentary streamers. As the field is increased the individual globules follow in such rapid succession along a single path that the streamers appear to be continuously visible. With stronger fields several streamers with nearly parallel paths are observed and then as the number of such streamers increases they join to form beautifully curved luminous surfaces. Finally by the multiplication of such surfaces there may appear to be certain regions which have a luminosity distributed throughout a volume.

By superimposing an alternating component on the direct current fed to the anode, or by heating the cathode by alternating current, the streamers or individual globules move in sinusoidal paths which reproduce accurately the wave shape of the current even at frequencies up to 1,000 cycles. Sometimes the arc-discharge itself oscillates at frequencies in the neighborhood of 1,000 cycles and the globules then increase and decrease periodically in brilliancy so that the streamer due to a single globule appears beaded.

By "stroking" the tube up or down with the magnet, the tungsten responsible for the streamer discharge can be concentrated at will at the upper or lower end of the tube.

All these effects persist for hours as long as the arc current is maintained at about one ampere without any necessity for replenishing the supply of tungsten vapor.

If the arc current is stopped for 5 seconds and restarted without lowering the filament temperature, the streamer discharge phenomena persist with only a moderate decrease in intensity. But if the arc is allowed to remain out for as much as 40 seconds practically all the effects due to tungsten vapor disappear. To restart the streamer discharge more tungsten must be introduced by sputtering tungsten from the cathode or from an auxiliary electrode at high negative potential or by vaporizing tungsten from a filament at temperatures of 3000° K or more.

Similar effects can be obtained by sputtering molybdenum, tantalum or carbon into the arc, but the phenomena seem to be more striking and more persistent with tungsten.

By focusing a concentrated beam of sunlight into the tube containing a streamer discharge the yellow skin of the arc (or with weak excitation a region just outside the yellow skin) scatters light which appears to be completely polarized when observed at right angles to the incident light. By this method the skin of the arc in presence of a magnetic field can be seen to extend far beyond the luminous yellow skin. In the presence of the field there is some light scattered from the whole of the non-luminous gas outside the arc, but the intensity increases rapidly as the skin is approached. No scattered light is detected from the interior of the arc except from the streamers or globules that pass through it and these give very intense scattering.

When a short constriction is placed at a point in the tube carrying the arc and particularly when the tungsten has been concentrated in this constriction by stroking by a magnet, a brilliant light (continuous spectrum) is emitted from a thin skin which remains within a fraction of a mm of the wall even after the magnetic field is removed.

A fairly complete explanation of these phenomena together with quantitative data for testing the theory will be published in the *Journal* of the Franklin Institute. The following is a brief outline of the theory.

The walls of the tube are negatively charged and the tungsten atoms and particles in the region outside the arc also become negatively charged and thus can not deposit on the walls. In the arc there is a high concentration of free electrons moving in random directions while outside the arc the concentration is low. Thus, according to the Boltzman equation (or the Nernst electro-chemical equation), there must be a potential difference between the interior of the arc and the surrounding space (the arc being positive). The potential distribution must therefore be such that the potential gradient is zero at the axis of the arc, increases to a maximum near the skin of the arc and again becomes small near the walls. Thus from Poisson's equation near the boundary of the arc there must be an electric double layer consisting of an inner sheath having a positive space charge and an outer sheath with a negative charge.

Such a double layer in a gas can only be maintained if the positive ions which continually escape through the positive sheath disappear by recombination at the inner edge of the negative sheath. The presence of particles (or ions) which can take up negative charges will not only bring about such recombinations but will aid in the formation of the negative space charge. At the boundary between the positive and negative sheaths negative tungsten ions lose their charge and in the neutral state no longer repel one another. They can thus condense on one another to form minute solid particles.

The effect of the magnetic field is solely to produce convection currents in the argon due to the non-uniform distribution of current throughout the cross-section. The convection currents cause the arc to be carried to one side of the tube and cause the non-luminous gas carrying negatively charged tungsten ions and particles to flow into the arc on the side away from the wall. At the junction between the negative and positive sheaths all the negative ions and larger particles lose their charges and become either neutral or positive. The neutral atoms and particles then no longer repel one another and thus grow to larger aggregates. As these are carried into the positive sheath they are heated by the energy set free by the recombination of positive argon atoms and electrons and are ultimately disintegrated or evaporated by this positive ion bombardment. The resulting tungsten atoms become positively charged within the positive sheath, and migrate under the influence of the electric field in the opposite direction to that of the convection current. The tungsten thus accumulates at the boundary between the positive and negative sheaths in the form of minute solid particles or aggregates. If any transverse motion causes more rapid concentration at some places than others the increased recombination at these places makes the sheaths more sharply defined and still further increases the rate of accumulation of tungsten. When sufficient tungsten is present at any place to cause practically complete recombination of the positive ions, the skin projects into the arc and then because the direction of migration of the particles in the electric field becomes nearly perpendicular to the direction of the convection currents, the skin forms a kind of funnel from the narrow end of which the globules break away and are carried at the velocity of the convection currents into the body of the arc.

The structure of a detached globule is thus essentially similar to that of the detached arc itself except that it is turned inside out, as can be readily understood from its mode of function.

Thus we must conclude that the inside of a detached globule is negatively charged and that this is surrounded by a positive ion sheath. The tungsten is imprisoned inside the globule in the form of solid particles which are concentrated particularly at the boundary of the regions of positive and negative charge.

The recombination of ions furnishes the energy for the heating of the particles and the maintenance of the electric fields.

These glowing detached globules seem to have characteristics similar in many respects to those that have been described as belonging to ball lightning. It is perhaps not certain that ball lightning is anything more than a psychological phenomenon, but if it has objective reality it may possibly be due to causes similar to those outlined above: the presence of highly ionized gas, recombination of ions on catalytically acting solid particles which are held within the ball by their charges and the electric field at the surface of the ball.

IRVING LANGMUIR,
C. G. FOUND,
A. F. DITTMER

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THE RACIAL ORIGIN OF ALMSHOUSE PAUPERS IN THE UNITED STATES[1]

DURING and since the war our lawgivers seem to have been more concerned about the racial heterogeneity of the American people than for many years before. Under expert eugenic advice a new immigration law has recently been passed by congress, care-

[1] Papers from the Department of Biometry and Vital Statistics, School of Hygiene and Public Health, The Johns Hopkins University, No. 110.

fully calculated, so that body and the public were told, to make relatively easy the coming of "desirable" racial elements, and relatively difficult the entrance of "undesirable" racial elements. The soundness of the foundations of the expert eugenic advice has been somewhat called in question by Jennings, Buchholz and various other persons who have taken the trouble to look into the evidence which was presented to congress, and which apparently, in some degree at least, influenced that body's action. But in any event the deed is done, and is widely hailed as a triumph of eugenics. Even with this political *fait accompli*, however, data on any aspect of race in the United States are always welcome.

These considerations, and some others, lead me to call attention here to some statistics very recently issued by the Bureau of the Census in an eight-page pamphlet entitled "Paupers in Almshouses: 1923." "These statistics relate only to inmates of public almshouses and do not include inmates of any other institutions or recipients of outdoor relief." In spite of this limitation the figures presented have a good deal of significance. I shall discuss here only one of the many interesting points which the figures raise, namely, the racial background of our public almshouse pauperism.

It appears that there were enumerated on January 1, 1923, 72,336 white paupers in almshouses, and 5,511 negro paupers in the same situation, these figures being, respectively, 92.6 and 7.1 per cent., or together 99.7 per cent. of all the paupers in almshouses at that date. Inasmuch as at the census of 1920 the negroes constituted 9.9 per cent. of the total population of the country, it appears that the negro certainly made no worse showing in respect of almshouse pauperism than the white, and in fact a somewhat though not greatly better one. The same thing was true in 1910. The decrease in the proportion of almshouse paupers to the total population between 1910 and 1923 was more marked in the case of negroes than in native whites, with which group of whites the negroes may most properly be compared; for while the number of native white almshouse paupers decreased from 65.0 per 100,000 of the same class of the population in 1910 to 59.8 in 1923 (5.2 points), the number of negroes in the same situation decreased from 63.9 per 100,000 of the same class of the population to 52.7 (11.2 points). Keeping in mind always the cautionary fact that these figures relate to paupers in public almshouses only, it would appear that any social indictment of the negro race, as a race, in respect of pauperism would probably be difficult to maintain.

Turning now to the whites, it appears that of the 72,336 in almshouses on January 1, 1923, 48,019, or 66.4 per cent., were native-born; 23,557, or 32.6 per cent., were foreign-born, and 760, or 1.0 per cent., were of unknown nativity. The corresponding percentages on January 1, 1910, were: For native-born 56.9 per cent., for foreign-born 42.6 per cent. and for persons of unknown nativity 0.5 per cent. These facts would appear to suggest that during the period covered a change has come about, which has had as its result a distinct diminution in the proportion of foreign-born to total white almshouse paupers. The available data furnish no means of determining the nature of the social forces which have produced this change. The fact, however, is interesting. It means that we were paying for the care of nearly 10,000 *fewer* foreign-born white persons in almshouses in 1923 than in 1910, while at the same time we were paying for nearly 4,000 *more* native-born white persons in 1923 than in 1910. Such meager comfort as is, insofar, derivable from this whole unfortunate situation plainly appears to be offered by the foreign-born and not the native-born.

But there is another statistical angle to the case which must not be overlooked, particularly as it is almost the only one that is commonly presented. While on January 1, 1923, there were in almshouses 59.8 native-born white persons per 100,000 of the same class in the population, the corresponding figure for the foreign-born was 173.6. This is by some regarded as a fact of dread significance. Perhaps it is. To me it seems possibly only an interesting expression of the difficulties which the human organism finds in adapting itself to a new environment. A high pauperism rate of foreign-born can, of course, be eliminated by so arranging matters that there are no foreign-born in the population. But in any circumstances which permit foreign-born persons to settle in this country, it seems probable that their pauperism rate will be higher than that of natives. Furthermore, the mental discomfort engendered by the higher foreign-born *rate* of pauperism would seem to be in some degree mitigated by the fact, already brought out, that we are, on the evidence, paying for the upkeep of a *decreasing absolute* number of foreign-born paupers in almshouses all the time. It is absolute mouths that it costs money to feed. High *rates* may be relatively inexpensive things.

Further light on this phase of the matter is afforded by the figures:

	Paupers in almshouses, enumerated on stated date, per 100,000 of the same class of the population	
	Jan. 1, 1910	Jan. 1, 1923
Native white	65.0	59.8
Foreign-born white	249.3	173.6

The decrease in the period is definitely more marked in the case of the foreign than in that of the native-born. This is made clear in Fig. 1, which is a ratio

TABLE I

COUNTRY OF BIRTH OF FOREIGN-BORN WHITE PAUPERS IN ALMSHOUSES, 1923

Country of birth	Foreign-born white paupers in almshouses: Enumerated Jan. 1, 1923, Per cent. distribution	Foreign-born white paupers in almshouses: Admitted during 1922, Per cent. distribution	Per cent. distribution of foreign-born population of U. S., 1920	Difference between first and third columns
All countries	100.0	100.0	100.0	
Northwestern Europe:				
England	8.0	7.2	5.9	+ 2.1
Scotland	2.6	2.5	1.9	+ 0.7
Wales	0.9	0.7	0.5	+ 0.4
Ireland	26.2	24.0	7.6	+18.6
Norway	2.0	1.5	2.7	— 0.7
Sweden	5.0	3.8	4.6	+ 0.4
Denmark	1.3	1.0	1.4	— 0.1
Netherlands	0.7	0.6	1.0	— 0.3
Belgium and Luxemburg	0.5	0.4	0.5	0.0
Switzerland	1.6	1.2	0.9	+ 0.7
France	1.5	1.2	1.1	+ 0.4
Central Europe:				
Germany	20.8	13.7	12.3	+ 8.5
Poland	4.4	6.4	8.3	— 3.9
Czechoslovakia	2.8	3.2	2.6	+ 0.2
Austria	1.9	2.7	4.2	— 2.3
Hungary	1.4	1.9	2.9	— 1.5
Jugo-Slavia	0.5	0.7	1.2	— 0.7
Southern and Eastern Europe:				
Russia	2.2	3.9	10.2	— 8.0
Lithuania	0.7	0.9	1.0	— 0.3
Finland	1.0	1.3	1.1	— 0.1
Greece	0.3	0.9	1.3	— 1.0
Italy	3.1	5.4	11.7	— 8.6
All other	0.6	1.4	1.8	— 1.2
America:				
Canada—French	2.5	2.9	2.2	+ 0.3
Canada—Other and Newfoundland	5.5	5.8	6.0	— 0.5
Mexico	0.8	2.7	3.5	— 2.7
All other	0.1	0.2	0.3	— 0.2
All other countries and unknown	1.2	1.8	1.3	— 0.1

chart on an arithlog grid, used to make the slopes of lines visually comparable.

The admissions during the year show the same thing as the enumerations. I have added the lines for admissions in Fig. 1, but will not take the space to give the figures.

Let us turn now to the consideration of the data which are the most interesting of all from the standpoint of human biology, namely, the figures which show the country of birth of the foreign-born white paupers in almshouses in 1923. Table I presents the essential material.

The figures in the last column of Table I are exhibited graphically in Fig. 2.

The table and diagram require little comment. With a few trifling exceptions, all the countries from which the present law *encourages* immigration contributed to almshouse pauperism in 1923 in *excess* of their representation in the population in 1920. On the other hand, again with a few trifling exceptions, those countries from which the present immigration law was especially framed to *discourage* immigration appear in the lower part of the diagram, because they contribute a *smaller* proportion to almshouse pauper-

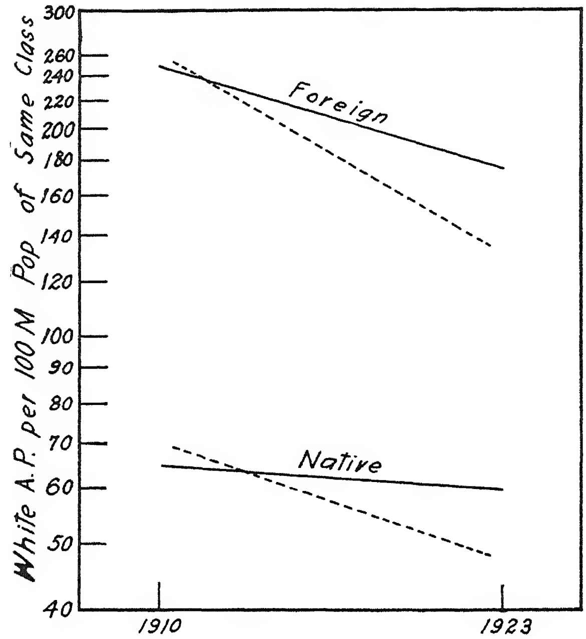

FIG. 1. Ratio chart showing decrease in proportion of almshouse paupers to the total population from 1910 to 1923. Solid lines, enumerated on January 1 of year; broken lines, paupers admitted to almshouse during years 1910 and 1922.

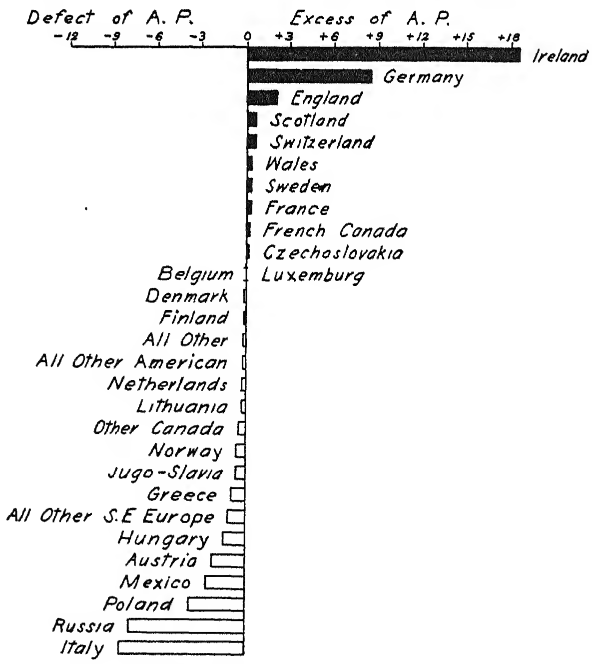

FIG. 2. Showing the excess (black bars) or defect (white bars) of the percentage presentation of different racial groups in public almshouses, as compared with their representation in the general population.

ism in 1923 than their representation in the general population in 1920. Immigration from five countries in particular, Austria, Mexico, Poland, Russia and Italy, has been subjected to much criticism. It is interesting to note that the immigrants from each of these five countries contributed proportionately *less* to our almshouse pauperism in 1923 than any other group of foreign-born people in the country.

RAYMOND PEARL
THE JOHNS HOPKINS UNIVERSITY

ROMEYN BECK HOUGH—1857–1924

WHEN an official or one connected with an outstanding educational institution ceases his scientific work, the fact is noted usually and his life effort is appraised. When, as an amateur, he has rendered comparable service to science, this is more likely to be overlooked.

Romeyn Hough is one whose contributions to a knowledge of North American trees ought not to be overlooked because his name may be sought in vain year after year in the bibliographic records of dendrology. He may never have appended his name to a specific binomial or a varietal trinomial. He may never have expressed in print curiosity even as to why some people put dogwood and peperidge into one family, while others consider them representative of two families. But, accepting the taxonomic and nomenclatorial views of those whom he felt disposed to consider authoritative on these vexed questions, he did very much to make it easier for people to become acquainted personally with our trees.

His interest in nature was not artificially implanted and skilfully nourished; it was inherited. Forestry as a national interest took form under his father, Franklin B. Hough. To father and son natural history was a matter of out-of-doors; the real thing appealed to them rather than its presentment. Before Romeyn entered college he knew a great deal of nature—the kind of nature-lore that few have and still fewer teach now-a-days. One of the privileges of my early years at Cornell was to get afield with him. Only last fall we recalled a never-to-be-forgotten example of mother love that a flying squirrel showed us nearly fifty years ago.

Hough never became a teacher: perhaps he was not drawn to the routine of pointing out to others what he found pleasure in seeking out for himself. He qualified as a physician, like his father; but he really became in a sense a manufacturer and publisher, combining avocation with vocation, for he manufactured structural sections—macroscopic and microscopic—of the trees that he knew so well.

Many years ago, Nordlinger issued a series of small thin cross-sections of German and exotic woods. I think that eleven centuries of these were issued. A

few other scarcely notable series of the same kind have been published. Hough conceived the idea of issuing our native woods in larger sections, representing side by side the three—cross, radial and tangential—needed for a stereo visualization of the stem structure. Thirteen fascicles, of twenty-five species each, have been published; and these auto-illustrations stand alone in their field. Mastering the technique of cutting such sections opened a commercial industry in cross-section business cards and the like, the use of which he promoted extensively.

Monographs and manuals of North American trees are many and varied; unique among them is Hough's "Handbook of the Trees of the Northern United States and Canada," with its admirably selected and prepared phototype and distribution map and a photographic reproduction of the cross-section of the wood of each species.

It is to be regretted that their author did not live to bring out two contemplated additional fascicles of the sections of American woods, and a "Handbook of Western Trees" that he planned as a companion to the eastern volume; but there is reason to hope that the materials for both are sufficiently in hand to insure their publication. Whether this be so or not, however, Romeyn B. Hough has made a rare contribution to American botany in a model book, and especially in a series of illustrations consisting of the woods themselves—which, unlike texts and drawings, never can become out-of-date nor be found to contain untruths except as the names applied in his day to the trees he sectioned undergo change with progressing knowledge.

William Trelease

University of Illinois

SCIENTIFIC EVENTS

THE INTERNATIONAL GEOGRAPHICAL CONGRESS[1]

The project of an International Geographical Congress to be held at Cairo in 1925 was first discussed over two years ago in association with the coming jubilee of the foundation of the Sultanieh Geographical Society of Egypt. It soon developed into a plan for the revival of the old international congresses held in different countries before the war, being regarded by its promoters in Rome (where the tenth congress was held) as the eleventh of the series. Circulars of invitation were issued on this basis by a committee formed in Egypt, but it was pointed out that by the decision of the International Research Council, formed shortly after the end of the war, the constitution of the old Congress was abrogated, and that the duty of organizing future congresses should rest with the International Geographical Union formed in Brussels in July 1922 in affiliation with the International Research Council. A somewhat delicate situation thus arose which has since been happily regularized by the adhesion of Egypt to the International Research Council, and the issue of new circulars of invitation under the Statutes of the International Geographical Union. The congress will take place (probably from April 2 to 12, 1925) under the patronage of King Fuad I, and will be organized by the Royal Geographical Society of Egypt, from whose members the organizing committee is chosen. The Secretariat and inquiry office are installed in the premises of that society in the Public Works Ministry Garden, and a handbook of information has been issued giving details of the arrangements so far made. Tickets of membership will be issued at a charge of £1, and will confer all benefits in the way of reduction of fares by steamer and railway, etc. The meetings will take place at various centers in Cairo and Alexandria. A provisional program has been drawn up, covering the various principal branches of geography and their subdivisions, and a scheme of excursions arranged, the two principal being, (1) that from Cairo to Aswân or Wadi Halfa, (2) that on the Gulf of Suez and the Red Sea. The handbook includes useful general information on Egyptian matters, together with a geological map (showing routes of excursions) and a plan of Cairo.

[1] From *The Geographical Journal.*

EXHIBITION OF THE AMERICAN ASSOCIATION AT WASHINGTON

An exhibition of new scientific apparatus, research methods and results of scientific research is being planned as an important feature of the fifth Washington meeting of the American Association and associated organizations. Previous efforts of the association in this direction have been increasingly successful and the Washington exhibition promises to surpass earlier ones in value and interest to research workers and teachers in all fields of science. Manufacturers of scientific apparatus and supplies, and publishers of scientific books, are showing a renewed and increased interest, and many firms will be represented. It is hoped that individual investigators will also take an active part, exhibiting new devices, improvements in apparatus and methods, specially fine preparations, etc., thus giving to the whole undertaking a personal element that will be greatly appreciated. Members of the association and members of associated organizations are cordially invited and urged to help in this way. Those in charge of research laboratories are

asked to arrange for exhibits to represent their various lines of work. Manufacturers and publishers are also heartily invited to exhibit their products. No charge is to be made for the entry of any exhibits, but the requisite space should be arranged for in advance and each exhibit should be placed and cared for by the exhibitor or his representative. The association will make arrangements for the necessary rooms, lighting, etc., but of course can not be responsible for the articles and materials exhibited. Arrangements for the entering of exhibits, by individual scientists and research laboratories as well as by manufacturers and publishers, are to be made by correspondence with Dr. Charles A. Shull, Department of Botany, the University of Chicago.

Many of the research laboratories of Washington are to be open for visit and inspection by those who attend the approaching Washington meeting and numerous special devices and research methods will be on exhibition in this way.

It seems clear that these American Association for the Advancement of Science exhibitions should become increasingly valuable as definite aids to the advancement of American science. Great progress has already been made, but this feature of the annual all-science meetings is worthy of much more attention than has been accorded it in the past. These meetings are unique in the fact that they offer each year the only opportunity for a large and representative gathering of all kinds of scientific workers and teachers of the sciences from all parts of the United States and Canada. Attendance at the annual gatherings in recent years has been about two thousand and it is safe to predict that a much larger number will attend the Washington meeting next December. It is specially desirable that scientific workers should be acquainted with the activities of their colleagues, not only in their own respective fields but in all fields, for we are increasingly impressed with the essential unity of science. The annual exhibitions furnish a very valuable and helpful means toward this end and a much needed adjunct to the presentation of papers before the several societies and sections.

BURTON E. LIVINGSTON,
Permanent Secretary

MEETING OF THE AMERICAN STATISTICAL ASSOCIATION

THE eighty-sixth annual meeting of the American Statistical Association will be held at Chicago on December 29 and 31. The experiment tried out last year of having the several sessions of the annual meeting deal with various phases of one general subject proved so successful that it has been decided to repeat the plan at the coming annual meeting of the association. The president, after consultation with other members of the association, has selected the topic "Population," and has developed a program on that theme. The subject is not only of great importance both theoretically and practically, but is one in which the statistician is in a strategic position to make a vital contribution to current political and economic thought. Moreover, it is a subject which bears directly upon the research activities of many of our members.

The subject of population is also arousing interest in allied scientific fields. For this reason it has been possible to arrange for joint sessions with the American Economic Association, and the American Association for Labor Legislation. With the economists we will discuss the connection between population and natural resources; with the labor legislation group the subject of population and the labor supply. In addition, we will develop independently three sessions, the first dealing with a statement of the problem and its various ramifications; the third dealing with the racial constitution of the population and the problem of immigration; and a final meeting in which we will discuss the outlook for the future, and the practical steps which should be taken in developing a rational public health, economic and social program.

As the subject is such a broad one and the time in which to cover it is so limited, the individual sessions are necessarily rather long and in some cases contain more papers than is altogether desirable. But it was necessary to arrange the program thus, in order to cover all angles of the subject and to round out every vital phase of the question. It is, therefore, impossible to appoint set persons to discuss each paper. But since many of our members are actively engaged in research work in this field, it should be possible to have a lively, even if it appear like an impromptu, discussion from the floor. There will be a reasonable length of time set aside expressly for such discussion and it is hoped that many of our members will show their interest by adding their contributions to the set papers which are scheduled.

Though the general outline of the program is fairly well settled, there is still time to make a few additions and changes and to this end suggestions and recommendations are earnestly requested. Information concerning original investigations now in process and the names of contributors who are doing valuable work on this subject should be sent to the president. Above all it is hoped that many members will attend and take an active part in the discussion. The success of the conference, as a whole, will depend upon the enthusiasm and whole-hearted support of each member.

LOUIS I. DUBLIN,
President

MUNSELL RESEARCH ASSISTANTSHIPS IN COLORIMETRY AT THE NATIONAL BUREAU OF STANDARDS

THE Munsell Research Laboratory has established two positions of research assistant in colorimetry to be stationed at the National Bureau of Standards, Washington, D. C.

The chief purpose of these assistantships is to provide for training interested and suitably qualified young men in the practice and technic as well as the theory of colorimetric measurements, in order that they may become eligible for higher positions of greater responsibility which it is expected will be open later to those who prove their competence for this kind of work.

These assistants will work in the section of colorimetry of the Bureau of Standards under the direction of Mr. Irwin G. Priest and Dr. K. S. Gibson. They will be in close contact with the work of the section, and will have unusual opportunities to learn by experience, observation and conference with other members of the staff. The work of this section includes spectrophotometry by various methods, colorimetry and research in visual psycho-physics. The chief duties of these positions will be to assist in research and testing involving the use of the spectrophotometer, the "monochromatic colorimeter" and various other photometric and colorimetric instruments used in testing and research. Opportunities for study will also be available.

Applicants must have the following qualifications for appointment:

(1) A *bona fide* desire and intention to specialize in this kind of research as a life work. (There is, of course, no contract or binding agreement on this point, but it is desired to make clear the condition that persons who have no interest except that of temporary employment while they are planning for some other field of work are not expected to apply for these positions.)

(2) A bachelor's degree or its approximate equivalent in previous education, including physics.

(3) Normal vision or only such refraction errors as are readily corrected.

(4) Normal color sense.

(5) Age limits: between 19 and 25 years.

Salaries will be between $1,600 and $2,500 per year. The exact amount will depend upon previous experience and education, and such recommendations as the applicant may submit; and will be fixed after conference with the applicant.

Appointments will be for a term of one year.

Applications for appointment or request for further information may be addressed to the Munsell Research Laboratory, 10 East Franklin St., Baltimore, Md.

NATIONAL RESEARCH FELLOWSHIPS IN THE MEDICAL SCIENCES

FOURTEEN fellows were appointed by the Medical Fellowship Board of the National Research Council on September 20, as follows:

Name	Place of Work	Subject
Miss E. B. Carrier, M.D., Johns Hopkins Hospital, Baltimore, Md.	Harvard Medical School	Physiology Anatomy
Benjamin Freeman, Ph.D., Columbia University, New York	Univ. of Pennsylvania	Physiology Pharmacology
M. S. Hollenberg, M.D., University of Manitoba, Winnipeg, Manitoba, Can.	Johns Hopkins Univ.	Physiology
Leuschner, Miss E. L., M.D., Johns Hopkins, Baltimore, Md.	(Not determined)	Pathology
A. E. Mirsky, Neponsit, L. I.	Cambridge Univ. Eng.	Physiology Biochemistry
H. L. Pelham, M.D., Howard University, Washington, D. C.	Columbia University	Physiology
Bernhard Steinberg, M.D., Boston University School of Medicine	Western Reserve	Pathology
F. W. Stewart, Ph.D., Harvard Medical School, Boston	Boston City Hospital	Pathology
G. J. Strean, M.D., McGill University, Montreal, Canada	Univ. of Iowa	Biochemistry
C. H. Thienes, M.D., University of Oregon, Portland, Oregon	Stanford Univ.	Pharmacology
H. B. VanDyke, Ph.D., M.D., University of Chicago	(Not determined)	Pharmacology

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held in Pierce Hall, Harvard University, Cambridge, on November 10 and 11, and in the building of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, on Wednesday, November 12. Members of the local reception committee are A. Lawrence Lowell, *honorary chairman;* Theodore Lyman, chairman; Edwin B. Wilson, *secretary;* S. W. Stratton, William C. Wait, G. H. Parker, Thomas Barbour, Hans Zinsser, W. H. Lawrence and A. B. Lamb.

ACCORDING to press dispatches, the Nobel prize for medicine has been awarded to Professor Willem Einthoven, professor of physiology in Leyden University.

DR. HARVEY W. WILEY was the guest at a dinner held in Washington on October 21, in celebration of his eightieth birthday and the fortieth anniversary of

the founding of the Association of Official Agricultural Chemists. R. E. Doolittle, president of the association, presented to Dr. Wiley a bronze medal commemorating his eightieth birthday and the founding of the association.

Dr. William H. Wilmer, of the recently established laboratory of ophthalmology in Washington, has had conferred upon him the decoration of Commander of the Legion of Honor by the French government.

Dr. Martin H. Fischer, of the University of Cincinnati, has received from the "Kolloid–Gesellschaft" the Laura R. Leonard prize of the year 1924. The presentation took place at Innsbruck, during the third general meeting of the society. Last year the Leonard prize was given to R. Zsigmondy and Dr. Pauli.

S. G. Blaylock, general manager of the Consolidated Mining and Smelting Company of Canada, has been awarded the McCharles prize by the University of Toronto for solving metallurgical problems involved in the successful treatment of certain complex ores.

The 1922–1923 research award of the American Congress on Internal Medicine to the University of Pennsylvania School of Medicine, Philadelphia, has been given to Drs. John H. Arnett and Karl Kornbloom for their work on "Vital capacity."

Dr. Hubert Sattler, formerly professor of ophthalmology at the Universities of Königsberg and Leipzig, celebrated his eightieth birthday on September 9.

The Rockefeller Institute for Medical Research announces the election of the following officers and members of the board of scientific directors: *Vice-president,* Dr. Theobald Smith, to succeed the late Dr. T. Mitchell Prudden; *secretary,* Dr. Francis Gilman Blake, to succeed the late Dr. L. Emmett Holt, and Dr. John Howland to fill the vacancy in the board created by the death of Dr. Holt.

At the Harvard University Museum, three emeritus professors, Dr. William M. Davis, Dr. Edward L. Mark and Dr. John E. Wolff, have been replaced on the committee of the museum by Professor Charles Palache, Professor Jay B. Woodworth and Professor Oakes Ames.

The Journal of General Physiology, until recently edited by the late Dr. Jacques Loeb, in association with Professor W. J. V. Osterhout, of Harvard University, will henceforth appear under the joint editorship of Dr. Osterhout, Dr. J. H. Northrop, of the Rockefeller Institute, and Dr. W. J. Crozier, of Rutgers University.

J. A. Carroll, of Sidney, has been appointed assistant director of the Solar Physics Observatory of the University of Cambridge for five years, in place of E. A. Milne, who has resigned.

Dr. R. M. Bronte, pathologist to the Home Office, England, has been elected the first president of the Harrow Scientific Society.

The Insular Department of Agriculture, of Porto Rico, has sent Dr. Melville T. Cook, plant pathologist, to St. Kitts, British West Indies, on a special mission in connection with the introduction of cotton seed. Dr. Cook sailed on October 10 and will be away about four weeks.

Professor George F. Warren, of Cornell University, has sailed for Europe as one of four experts selected by the Federal Tariff Commission, at the request of the American dairy interests, to investigate the methods and costs of Danish butter makers.

Three members of the engineering faculty will be absent from Cornell University during the coming term. Professor Myron A. Lee has leave of absence to do practical work with the Gleason Works in Rochester; Professor Frederick G. Switzer is with the Alabama Power Company and Professor Calvin D. Albert is studying machine design in European manufactories.

Members of the faculty of Harvard University who have been granted leaves of absence for the whole of this academic year include Dr. A. W. Sellards, assistant professor of tropical medicine; Edward V. Huntington, professor of mechanics, and G. W. Pierce, Rumford professor of physics and director of the Cruft Memorial Laboratory. Ten members of the faculty will be absent for the first half-year including Roland B. Dixon, professor of anthropology; Professor Edward M. East, of the department of biology; Professor W. F. Dearborn, of the school of education, and Professor Albert Sauveur, of the school of engineering. Nine professors will be absent for the second half-year including Lawrence J. Henderson, professor of biological chemistry; Harry E. Clifford, Gordon McKay professor of electrical engineering, and Dr. James B. Conant, assistant professor of chemistry.

Professor Emile Monnin Chamot, of Cornell University, has been appointed exchange engineering professor to France for the present academic year.

Professor O. H. Larson, head of the department of agricultural economics and farm management at the Agricultural College of Copenhagen, Denmark, is coming to the United States next February, to lecture at Cornell University.

Dr. Charles de la Vallée-Poussin, professor of mathematics at the University of Louvain, will give a course of six lectures at the Massachusetts Institute of Technology from November 1 to 16, as visiting professor to America on the Commission for Belgium Relief.

Dr. Wilfred T. Grenfell, of Labrador, was the guest of honor at a dinner of the Over-seas League, London, on September 26. On October 16, Dr. Grenfell gave a talk before the Royal Society of Medicine on "Medicine in a corner of the empire."

From October 17 to 20, Professor V. H. Blackman, of the Imperial College of Science, South Kensington, London, lectured before the members of the plant science groups of the University of Minnesota on the "Influence of electric currents on growth and on the physiological basis of parasitism," and joined in a number of informal discussions on the campus and in the field.

William Henry Patchell, English engineer, gave a public lecture on October 10 at the Carnegie Institute of Technology in Pittsburgh on "The world power conference at Wembley, England."

Dr. John B. Watson, consulting psychologist for the J. Walter Thompson Co., New York, lectured before the New York Academy of Sciences on October 20 on "Studying the human young."

Dr. S. H. Reynolds, professor of geology at Bristol University, England, addressed the Geology Club at the University of Iowa on "The British lower Carboniferous and the work of Arthur Vaughan."

Professor E. C. C. Baly, of the University of Liverpool, has given two lectures at the University of Illinois on "Reactions, particularly those taking place under the influence of light."

Dr. A. V. Hill, professor of physiology in University College, London, will give two lectures under the auspices of the University of Buffalo on November 8.

Dr. Harvey Fletcher, of the research laboratory of the Western Electric Company, lectured at the University of Iowa on October 20 on "Researches in audition" before the Physics Seminar, and to the public on "The properties of speech, music and noise in their relation to electrical communication."

The physics club of the Bureau of Standards announces a course of sixty lectures by Dr. P. R. Heyl on "The fundamental concepts of physics in the light of modern discovery." These lectures are being given at 4.30 p. m. on Mondays and Thursdays of each week beginning September 29.

Dr. William Botting Hemsley, F.R.S., British botanist and keeper of the herbarium at Kew Gardens, died on October 14, aged eighty years.

Otto Herner, the well-known British analytical chemist, died on September 9, aged seventy-one years.

James Britten, English botanist and for over forty years editor of the *Journal of Botany*, died on October 8 in his seventy-ninth year.

H. G. Smith, for many years assistant curator and economic chemist at the Sydney Technological Museum, known for his work on the essential oils of the Australian flora, died on September 19 at the age of seventy-three years.

Dr. Benjamin Auguste Broca, member of the Academy of Medicine and well-known French surgeon, died on October 3.

The death has recently been reported of Dr. N. M. Knipovich, a well-known Russian scientist, who was drowned in the Black Sea at Yalta. A correspondent writes: Two important expeditions are to his credit: the Murman Expedition of 1900 and the Caspian Expedition of 1904. He also studied and described fishes collected by the Russian Expedition to Spitzbergen. His works were published in the reports of the said expeditions (a series of many separate volumes, Russian with German and English résumés) in *Petermann's Geographische Mittheilungen*, "Annals Hydrologie, Marit. Meteorolog" and "Annals Mus. Zool. Acad. Sciences," Petersburg. He has been a representative of Russia at the "Conseil Internationale pour l'Exploration des Mers," and has for a long time been one of the curators of the Zoological Museum of Petrograd and lately professor of zoology at Petrograd Psycho-Neurological Institute. His special interests, however, were connected mostly with general hydro-biological questions (distribution of marine animals in connection with temperature, salinity of water, etc.) and he was considered for Russia —as Dr. Hjort for Norway—the most eminent explorer of marine life of Russian waters.

Allotments for the use of the American Association table at the Naples Zoological Station have been made to Dr. Otto Glaser, of Amherst College, for the period from February 15 to April 15, 1925; and to Dr. A. R. Moore, of Rutgers College, for the period from April 15 to June 30, 1925. As has been noted in these pages, the Naples Station has been reorganized, under the directorship of Dr. Reinhard Dohrn, son of the original director. It aims to maintain its enviable reputation of pre-war years. Exceptional facilities for biological research are available for workers with plants as well as for workers with animals. Men of science wishing to work at the Naples Station should correspond with the director. Those wishing to have the privileges of the American Association table should inform the permanent secretary of the association, at the Washington office of the organization, in the Smithsonian Institution Building.

The section of education of the American Association for the Advancement of Science meeting at Washington, D. C., from December 29 to January 3, has arranged the following program: Special applications of scientific methods to educational problems: Freeman, Courtis, Haggerty, Rugg and others; Scientific advancement in school administration: Strayer, Fowlfes, Hines, Ballou, Cubberley; The pre-school child: Woolley, Baldwin, Dearborn, Fernald, Gesell; Character education: Starbuck, McGrath, Neuman, Trow and others; Experimental education: Uhl, Henman, Barr, Buswell, Myers, Persing, Scott, Baker and others. The address of the retiring vice-president, Dr. Henry Holmes, is on "The new social order as seen from the standpoint of education."

The fourteenth annual meeting of the American College of Surgeons was held in New York from October 19 to 25, under the presidency of Dr. Charles Mayo, of Rochester, Minn. Among the foreign medical men present were: Dr. N. D. Royle and Dr. Ralph Worrall, of Sydney, Australia; Dr. John I. Hunter, lecturer on anatomy at the University of Sydney; Sir Henry Lindo Ferguson, of New Zealand; Professor James Herman, of Stockholm; Dr. Albert James Walton, of London; Dr. H. B. Devine and Dr. James Sands Elliot, of Wellington, New Zealand; Dr. Robert Hamilton Russell, of Melbourne, and Dr. Carrick Hey Robertson, also of New Zealand. Officers for next year were elected as follows: Dr. Rudolph Matas, of New Orleans, *President;* Dr. Eugene Hillhouse Pool, of New York, *Vice-president,* and Dr. John Sinclair McEachern, of Calgary, *Second Vice-president.*

A series of talks are being broadcasted by the Smithsonian Institution from Station WRC, Washington, at 8 P. M. as follows: On October 22, Dr. Frederick V. Coville, of the Department of Agriculture, spoke on "Curious plants." On November 6, Lieutenant Commander George E. Brant will speak on "What the ocean means to us," and on November 13, Dr. J. Walter Fewkes, chief of the Bureau of American Ethnology, Smithsonian Institution, will speak on "Indian cliff houses."

The National Social Hygiene Conference for 1924 will take place in Cincinnati, from November 19 to 22, headquarters being the Hotel Gibson. This conference will mark the tenth anniversary of the founding of the American Social Hygiene Association, and it will be held under the joint auspices of the national association and the Cincinnati Social Hygiene Society.

The New York Electrical Society held its 422nd meeting in the auditorium, Engineering Societies Building, New York, on October 23. M. Luckiesh, director of the Lighting Research Laboratory, National Lamp Works, gave a talk on "Light and work."

The first meeting of the governor's committee to investigate conditions pertaining to medical practice in the rural districts of New York was called by the temporary chairman, Professor Dwight Sanderson, of Cornell University, on February 1, at the office of the State Department of Health. Those present were Professor Sanderson; Dr. Orrin Wightman, president of the State Medical Society; Mrs. Grace A. Powell, president of the New York State Federation of Home Bureaus; Dr. Grant C. Madill, former president of the State Medical Society; Dr. Stover, of Amsterdam; State Senator Byrne, of Albany, and Dr. Nicoll, state commissioner of health. The committee elected Professor Sanderson permanent chairman, and, after considerable discussion, resolved to study ways and means by which an intensive survey could be made of some rural county, in order to determine definitely the adequacy of medical service especially in the more remote rural sections. The members of the committee were unanimous in their belief that this work should be gone into with an open mind and without regard to the consideration of any remedies which might later be agreed upon as the result of the survey.

A general conference on the Fusarium problem was held during June, July and part of August at the University of Wisconsin, which developed from studies carried on by the United Fruit Company on the wilt disease of bananas in Central America and was held in cooperation with the Bureau of Plant Industry, United States Department of Agriculture. Those present at the conference were Dr. H. W. Wollenweber, pathologist, Biologische Reichsanstalt für Land und Forstwirtschaft, Germany, and Dr. O. A. Reinking, pathologist, United Fruit Company, both representing the United Fruit Company, and Dr. C. D. Sherbakoff, pathologist, Agricultural Experiment Station, University of Tennessee; Miss Helen Johann, assistant pathologist, cereal investigations, and Mrs. Alice Bailey, junior pathologist, office of cotton, truck and forage crop disease investigations, representing the Bureau of Plant Industry, United States Department of Agriculture. The work of the conference covered, in so far as possible, the study, comparison and identification of specimens and cultures of fungi at present available. The studies were made on species from all sections of the sub-genus Fusarium, including important border-line strains, thereby making it possible to arrive at a uniform taxonomy of the group. Pure cultures and dried specimens of each of the species studied and identified will be placed in the office of pathological collections, Bureau of Plant Industry, United States Department of Agriculture.

Under authority of the Research Committee of the Archeological Society of Washington, Dr. Mitchell Carroll recently examined with Professor George Grant MacCurdy the prehistoric cave and rock-shelter known as Castel Merle in the commune of Sergeac, 30 minutes from Les Eyzies, considered by Dr. Hrdlička and other authorities as perhaps of equal promise with the now famous prehistoric sites of the region, and concluded a ten-year lease from the owner, M. Castanet, with sole privilege of excavation and control of the finds. This was made possible through the generosity of Colonel William Eric Fowler, one of the trustees of the society. The society entered upon an agreement with the American School of Prehistoric Research to conduct the excavations which began at once in charge of Professor MacCurdy, who has already announced the discovery of numerous prehistoric flint implements in addition to faunal remains. Half the archeological specimens found on the site are to be deposited with the U. S. National Museum as the property of the Archeological Society of Washington.

A correspondent writes: "One of the most interesting recent acquisitions by the Museum of the California Academy of Sciences is a magnificent specimen of the East African gorilla. The specimen is an adult male measuring six feet in height when standing erect; the chest measures 63 inches, the span of arms 91 inches and the weight was 480 pounds. These figures show that this specimen is one of the largest gorillas in any museum in the world. It was shot in the Birunga Mountains, north of Lake Kivu, in the eastern part of the Belgian Congo. It was artistically mounted by an expert taxidermist in London, from whom it was purchased for the academy by Mr. A. Kingsley Macomber, well-known clubman and capitalist of Burlingame and patron of the California Academy of Sciences."

Provision is made in the will of Andrew W. Preston, late president of the United Fruit Company, that in the event of the death of all heirs the estate shall be used "for advancing the science of chemistry in the United States." The estate is estimated to exceed $6,000,000.

The Deseret Museum of Salt Lake City, a general geological and biological collection containing one of the largest and most complete mineralogical collections in the West, was recently presented to the Brigham Young University, of Provo, Utah.

Fordham University dedicated on October 24 its recently completed seismic station to be one of the few in the world devoted exclusively to the recording of earthquake phenomena. The building is the gift of William J. Spain, of New York, in memory of his son, William J. Spain, Jr., a member of the class of 1924 at Fordham.

By unanimous vote the administrative board of the American Engineers Council has agreed to insist on abolition of the Department of the Interior of the Federal Government to be replaced by a Department of Public Works. The Department of the Interior was held to be archaic, and the motion, as put by L. P. Alford, of New York, and formally adopted, called for an aggressive course in support of the new plan.

Authority for the transfer of approximately 14,000 acres of public land in the Salt River Mountains of Arizona to Phoenix for public park purposes has been granted by the Interior Department. The sale for $1.25 an acre was authorized by the Congress. The land makes available recreational facilities for the entire Salt River Valley population of about 100,000, including Phoenix.

By far the most comprehensive and vigorous enforcement of the Alaska fishery laws and regulations ever undertaken has been in progress this season under the supervision of the United States Bureau of Fisheries. In southeastern Alaska alone approximately 75 special stream guards have been on duty. Six patrol vessels have been engaged and there has also been the regular force of employees. In other sections of Alaska this character of work has been expanded over that of former seasons. Various cases, including trap and vessel seizures, have been presented for court action. This is the first time that such seizures have been made, authority being derived from the recent Alaska fisheries act of June 6, 1924. Commissioner O'Malley has been in southeastern and central Alaska during most of the current fishing season giving personal supervision to salmon-protection activities. The results will be highly beneficial in reestablishing and maintaining this very valuable natural resource.

UNIVERSITY AND EDUCATIONAL NOTES

The movement, started last May by the alumni of St. Louis University, to raise $1,000,000 for a new medical college, has thus far brought a total of $410,000 in pledges, according to Dr. Hanau W. Loeb, dean of the school of medicine.

At the University of Oklahoma two new structures, the medical and engineering buildings, are nearing completion. These buildings are being constructed under the appropriation of $100,000 for each, made by the last state legislature.

The will of the late Charles L. Hutchinson, of Chicago, provides a bequest of $30,000 to Harvard University for the work of the Arnold Arboretum.

COLUMBIA UNIVERSITY has received a gift of $15,000 from the Borden Company to be used for research in the field of food chemistry and nutrition, and $6,000 from an anonymous donor for the laboratory of surgical research.

WESTMINSTER Hospital Medical School, London, has been offered by A. J. H. Carlill £20,000 towards the establishment of a pathological unit as a memorial to his father.

THE Jefferson Medical College has created a department of bronchoscopy and esophagoscopy. Dr. Chevalier Jackson, professor of laryngology in the college, has been elected to the professorship of the new department. Dr. Fielding O. Lewis has been elected to fill the chair vacated by Dr. Jackson.

DR. GEORGE A. TALBERT, associate professor of physiology at the University of Nebraska College of Medicine, has been appointed professor of physiology at the University of North Dakota School of Medicine.

DR. D. S. MORSE, of Cornell University, has been appointed assistant professor of mathematics at Union College.

DR. HARRY H. KNIGHT, assistant professor of entomology and curator of the insect collection at the Farm School of the University of Minnesota, has resigned to accept a similar position at the Iowa State College.

EDUARDO DIAZ LUQUE was recently appointed professor of physics at the Universidad Nacional in Mexico City; he is also doing work for the Mexican Light and Power Company.

PROFESSOR HENRY BRIGGS, who has been for several years professor of mining engineering in the Heriot-Watt College, Edinburgh, has been appointed to the newly established chair of mining in the University of Edinburgh.

DR. HANS V. HABERER, of the University of Innsbruck, has been appointed professor of surgery at the University of Graz, to take the place of Professor v. Hacker.

DISCUSSION AND CORRESPONDENCE

ALKALINE REACTION OF THE COTTON PLANT

IN an article which has recently appeared under the above title (SCIENCE, September 19, 1924, page 268), Mr. J. E. Mills has referred to some observations published about a year ago by Mr. C. M. Smith regarding the alkaline reaction of the dew of the cotton plant (*J. Agric. Research*, 1923, *26*, 192). The subject was incidentally considered by Mr. Smith in connection with an investigation of "arsenical injury to plants," and from an examination made by him of dew collected from the plants, he was led to conclude that its alkalinity was to be attributed to the presence of the bicarbonates of calcium and magnesium. It was also observed by him that "the dew gave a reaction alkaline even to phenolphthalein," which he stated would indicate the presence of soluble hydroxide or salts of very weak acids. Mr. Mills has now noted (*loc. cit.*) that it would hardly seem possible that the alkalinity of the dew can be attributed to these compounds.

In collaboration with the Bureau of Entomology of the U. S. Department of Agriculture an investigation was undertaken by the undersigned for the purpose of determining the volatile constituents of the cotton plant and of ascertaining their attraction for the boll-weevil. This work was begun in the summer of 1923 and has continued to engage our attention to the present time. Although the complete results of this investigation will be published in due course in a scientific periodical, in view of the above-mentioned article by Mr. J. E. Mills and also the statements relating to the subject from time to time in the daily press it seems desirable that we should now place on record some of our observations.

The chemistry of the cotton plant is a very complex subject, and although much progress has been made in our investigation of it, considerable time will still be required for its complete elucidation. We now particularly wish to state that we believe the alkalinity of the dew of the cotton plant to be attributable, at least in part, to the presence of ammonia and trimethylamine, since we have determined the presence of these substances in it and have also obtained the same substances in very much larger amounts from the products of distillation of the cotton plant with steam. Both ammonia and trimethylamine are evidently emanations from the plant, and it has already been ascertained that the trimethylamine possesses a particular attraction for the boll-weevil. An account of the numerous other substances that have been isolated from the cotton plant and completely identified must be reserved for a future publication.

FREDERICK B. POWER,
VICTOR K. CHESNUT

BUREAU OF CHEMISTRY,
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WASHINGTON, D. C.

RADIOACTIVITY OF RIPE TOMATOES

IN cooperation with the Bureau of Standards a project for experimental study was outlined in the

summer of 1923, the object being to determine whether or not any radioactive substance occurred in food and if so its significance. Owing to unforeseen circumstances, the experimental work could not be begun at that time. In June of the present year, however, a beginning was made, the food chosen being ripe tomatoes. These were washed in distilled water and then pulped by passing the fruit through a meat grinder of household size. The pulped fruit and juice, 900 cc altogether, was tested for radioactive substance in accordance with the procedure followed at the Bureau of Standards of the United States Department of Commerce, the determinations being made by W. H. Wadleigh, of that bureau. The glass flask containing the pulp and all the other equipment used was taken from stock which had not been exposed to radioactivity. The experimental conditions were such as to prevent the concentration of the pulped fruit and juice during the experiment.

The results obtained are reported in the following table in comparison with Washington city water which was used as a check, its radioactivity being known:

OCCURRENCE OF RADIOACTIVE SUBSTANCES IN RIPE TOMATOES

		Milimicrograms per liter
1924 June 11	Washington city water for comparison	1.00
June 17	Ripe tomato pulp and juice	3.28
June 24	do	4.20
July 2	do	0.98 result considered unreliable
July 10	do	1.45
July 15	do	1.14

After the first determination for radioactivity, the tomatoes were set aside and again tested at the end of a week. This procedure was continued, five tests in all being made with the original material.

The radioactivity noted, though relatively small, was pronounced, being more than three times as great as that of city water. It is also apparent that the amount diminished as time passed.

The topics which suggest themselves for consideration in continuing the work are numerous. One of primary importance is to determine whether or not the radio-active substance is carried into the fruit by ground water taken up by the growing plant or whether it had another origin. Others have to do with the relationship, if any, between such phenomena and nutrition problems now receiving attention.

C. F. LANGWORTHY

WASHINGTON, D. C.

THE METRIC SYSTEM

IN SCIENCE for September 5 there is a letter on the metric system which gives an incorrect impression as to the position of the engineering profession on this question.

The engineer necessarily uses the unit of measure that is the legal standard in the country where he is working, but it does not make any difference whether the unit used is a foot or a meter. The essential thing is that it shall be a *decimal* system, and the engineers of the world are now using a decimal system exclusively for all measurements and calculations. The unit of measure in this country is the foot, and all measurements are made in feet and decimal parts of a foot. The surveyor's chain or steel tape is 100 feet long, graduated in feet and tenths and hundredths. The leveling rod is graduated in tenths and hundredths with a vernier reading in thousandths of a foot. All measurements of every kind are made in these decimal divisions of the foot and all calculations for steel-work, track-work and earth-work, for it would be impossible to apply trigonometry to measurements expressed in feet and inches.

After the calculations are completed the engineer has to convert his decimal fractions into inches and sixteenths for the steel worker and into cubic yards for the grading contractor. Of course all mathematical handbooks for engineers contain tables for converting decimal parts of a foot into inches and sixty fourths, and all railway engineers learn the "twenty-seven times" multiplication table so that they can divide by twenty-seven as easily as most people can divide by twelve, but if manufacturers would use a decimal system also it would save the engineer a great deal of unnecessary trouble and many mistakes, for every translation from one system to the other introduces one more possibility of error.

There is no doubt that a duodecimal system would be more convenient sometimes if our system of numbers were also duodecimal, but the important thing is that our system of measures should agree with our system of numbers.

KENNETH HARTLEY

CHEYENNE MOUNTAIN HIGH SCHOOL,
COLORADO SPRINGS, COLORADO

THE letter by Mr. John Satterly regarding the use of metric weights and measures which appeared in the September 5th issue of SCIENCE is of special interest. From visits to Canada, east and west, I can state that his attitude is very unusual. The work of Dr. J. C. McLennan, of Toronto University, is important in this connection. He writes:

In the early part of 1906, at the request of the Honorable L. B. Brodeur, minister of inland revenue of the Dominion Government of Canada, I agreed to deliver

a number of lectures on the use of metric weights and measures.

Through the cooperation of the department mentioned, a schedule of the lectures was arranged and it was made known in various centers throughout Canada that my services in connection with the metric campaign would be available on certain dates for the various local societies interested in this subject.

In carrying out this rather strenuous schedule, lectures were given in Montreal, Ottawa, Toronto, Winnipeg, Regina, Vancouver and in over thirty other Canadian cities. In some places the idea of the simple metric system corresponding to decimal currency was then new to many people. Our meetings were well attended; in some cases as many as six hundred people being present. At the close of each address all present were invited to take part in the discussion of the subject. The pros and cons were propounded with the utmost frankness and in some cases with considerable vigor. Never during this lecture tour or at any other time have I heard, in so far as I can judge, a really valid argument against the general use of metric weights and measures. On the other hand the many valid reasons for their use increase as time passes.

It is highly desirable that this preliminary educational work, conducted entirely at the expense of our government, should be effectively followed up. It is chiefly for the purpose of encouraging others to do their part in securing for Canada the advantages of the use of the metric system that on April 28, 1922, I accepted the chairmanship of the Toronto Section of the Metric Association. At that time Mr. W. P. Dobson, of the Hydro-Electric Power Commission, was elected secretary, and Mr. L. Burpee, of the Canadian General Electric Company, Ltd., was elected treasurer. Our section is composed of volunteer workers who desire to see the metric campaign progress as it should. We believe that everybody can do something to help. We hope that a great many people will let Mr. Dobson know that they will help the metric movement in their own industry or line of work.

The Metric Association has a local section and a good group of members in Toronto. In the French-speaking portions of Canada the public opinion in favor of the metric system is almost unanimous.

Howard Richards

Metric Association,
New York, N. Y.

QUOTATIONS

SCIENTIFIC RESEARCH

The patient technique of laboratory research does not seek the limelight of sensational discovery. For this reason the public mind does not grasp completely the significance of the work carried on by hundreds of students, up and down the country, whose investigations are bringing greater worth and purpose to the conditions of national life. The Report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1923–24 serves to remind us of the ever-increasing dependence of health, commerce and industry on the adequate opportunities afforded for scientific inquiry and accomplishment. The problem is, however, less a financial than an educational one. Money for research is there—over half a million was spent during 1923–24—but often the speed at which work can be carried out is limited—as in the case of the Fuel Research Board—"by the number of competent and trained workers available." It is to the university that we must look to give us the trained student, patient though adventurous, imaginative though cautious, cooperating without self-seeking to increase the sum of human knowledge. We have to ensure, also, that no alert and creative mind is barred from that training through lack of means to rise through the secondary school to the university. There is still too much reason to fear that reserves of ability are untapped owing to the failure of certain local education authorities to make careful provision for the poorer scholars. Last year 291 grants were made by the council to research workers and students in training, of which 244 were allowances enabling them to take advantage of facilities for training in research afforded by various universities. The grants made during the academic year 1923–24 amounted to £41,000 as compared with £49,000 during 1922–23. The transfer to university and college authorities of the responsibility for recommending rates of allowance in accordance with the needs of individual students has led to more generous help from local funds and greater local interest in these activities. Nevertheless, the powers of local authorities under section 74 of the Education Act, 1921, are not so fully utilized as they might be.

There are, however, other considerations beyond the financial which need to be taken into account in the training of students for research. Sir William McCormick, the administrative chairman of the Advisory Council, warns against too easy specialization. "Experience has taught us," he says, "to attach great importance to the student's school history, and our conviction grows that in the last two years of school life science must not be allowed to absorb the whole of the students' attention, to the exclusion of the humanities and to the detriment of his general education"; and Sir William urges further that "at a later stage, when the student has graduated and is serving his apprenticeship to research, we should like to see him encouraged to devote attention as part of his training to the historical and cultural aspects of the subject in which he is specializing." Inability to interpret contemporary social phenomena by the light of the past has been one of the causes which have often prevented expansion of method and the acceptance of

new ideas by leaders of industry. The war destroyed much of the crippling conservatism which had hitherto hampered development. The outcome is to be seen in more scientific organization and production in factory and workshop. Probably no movement has been of greater value to industry than the setting up of research associations in 1918, 1919 and 1920 under the government's scheme for industrial research and the consequent growth of cooperation and team work in dealing with problems common to the methods and processes of the various trades. The report shows that many of these problems are incapable of solution by one branch of science alone, and consequently it is essential that there should be increasing cooperation between chemists and physicists, biologists and engineers. An interesting instance of cooperation with medical research is seen in the financial help given to the Medical Research Council, accompanied by expert assistance from the Engineering Research Board, to enable the council to investigate problems of machine design in relation to the comfort and efficiency of the operator. Employers are only now beginning to understand how greatly industrial contentment, efficiency and output can be increased by comfort in manipulation and adequate light and ventilation in the factory.

There is need also to educate public opinion in regard to the value of research in the domain of national health, and the work of the Fuel Research Board in this direction should receive more general recognition. The Gas Regulation Act of 1920, which was based on the work of the board, has already led to substantial savings. The physical and chemical survey of the national coal resources, the research in carbonization and in by-products, the possible modification of the blast furnace are all likely to have important bearing on the prevention of waste and the diminution of the smoke evil. Public opinion, however, must press for proper fuel control in industrial works; "without it," says the report, "the advantages of better fuel which research may provide would be largely nugatory."—*Educational Supplement of the London Times.*

SCIENTIFIC BOOKS

The Physiology of Photosynthesis. By SIR JAGADIS CHUNDER BOSE. Longmans, Green and Co., New York, 1924; VII—287 pp., with 60 illustrations.

THE work under review comprises twenty-eight short chapters on about as many separate problems of the phenomenon of photosynthesis. The author confines himself largely to a description of apparatus and experiments of his own design and the results he has obtained therewith. The experiments were carried out with the water plant, *Hydrilla verticilla,* and the evolution of oxygen from the plant during illumination was taken as a measure of the rate of photosynthesis. As has been known for a long time, the gas which is emitted from an illuminated plant is not composed of pure oxygen but contains varying amounts of nitrogen and carbon dioxide. In order to avoid this source of error in the determination of photosynthetic activity by the volume of oxygen emitted, the author, in one of the methods described, removes the nitrogen from the water and the plant by placing these under a vacuum at the beginning of the experiment. It is stated that under these conditions pure oxygen is evolved in the light. Another familiar error in the bubble-counting method is due to the variation in the volume of the bubbles. This error the author has endeavored to remove by the use of a device which collects a definite volume of gas; a slight increase in the pressure of the gas causes its release, which is recorded on a revolving drum. By means of this apparatus, which was also elaborated into an automatic recorder of photosynthesis, a variety of factors which influence the rate of photosynthesis were studied.

In the results obtained on the relation between light intensity and photosynthetic activity no new contributions are made. Thus it is concluded (p. 48) that "Taking all factors into account, we find that *the activity of photosynthesis is proportional to the quantity of incident light.*" It is most unfortunate that absolutely no regard should have been taken of the mass of valuable information which has accumulated during the past twenty-five years on this and many other phases of the photosynthesis problem. In the arrangement of the experiments and in the interpretation of the results obtained the facts which led to the formulation of the theory of limiting factors are entirely disregarded, nor is there any consideration of the conclusions of other recent workers in the field, such as Harder and Lubimenko. The result of this general neglect in endeavoring to coordinate the observations recorded with the body of existing knowledge in photosynthesis is a most unsatisfactory one. Many of the phases of the photosynthesis problems are touched upon; none of them have been subjected to a thorough investigation. There are many interesting observations recorded, but their bearing is not certain because either they are purely unconnected or incomplete.

Interesting are the results of traces of iodine, formaldehyde and nitric acid on the photosynthetic activity. It was found that minute traces of these substances accelerate the activity enormously. Less fortunate are the author's conceptions of the "period of photosynthetic induction" and "photic stress"; the phenomena observed have been fully discussed some

years ago by Kniep and others. Chapters XIII and XIV describe an ingenious self-recording radiograph and a portable photometer which make use of the selenium cell as the light sensitive element.

The question of the influence of CO_2-concentration on the rate of photosynthesis has received much attention during the past ten years. It is of particular importance on account of its bearing on Blackman's theory of limiting factors. That the curve of photosynthetic activity with varying concentration of CO_2 and constant light intensity exhibits no sharp turn but is rather approximately a logarithmic one was indicated by the results of Boysen-Jensen (1917), Willstaetter (1918), Warburg (1919), Harder (1921). Bose also concludes: "My results show that the top of the photosynthetic curve rounds off gradually after the turning-point, and is never abruptly horizontal . . ." Only one light intensity was used; had similar experiments been carried out with a variety of light intensities they would have constituted a valuable test of Harder's conception of limiting factors. An attempt is also made to determine the oxygen-carbohydrate factor, a ratio between the weight of oxygen emitted and that of carbohydrate elaborated during photosynthesis. On the basis of the chemical equation commonly assumed to represent the photosynthetic reaction: $6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$ this ratio would be $\frac{C_6H_{12}O_6}{6O_2} = \frac{180}{192} = 0.9375$. The author measured the gas emitted and determined the increase in weight during a definite period of photosynthetic activity. He comes to the conclusion that the oxygen-carbohydrate factor is 0.8906 or 5 per cent. less than the theoretical value. This is called the normal value. In specimens which previously had been exposed to strong light the factor was 0.91, in those exposed to semi-darkness 0.87. The explanation for these discrepancies is sought in the possibility that other carbohydrates besides those having a molecular weight of 180 are elaborated. Apparently the fact, clearly established by Kniep, was lost sight of: that the gas evolved in photosynthesis is not pure oxygen, the composition varying with the rate of gas evolution. Analyses of the gas were not made nor were precautions taken to avoid admixture of other gases. The low value of the $\frac{\text{carbohydrate}}{\text{oxygen}}$ ratio is in all probability due to the fact that the gas collected was not pure oxygen. Furthermore, under conditions of high light intensity (more active photosynthesis) the proportion of oxygen in the emitted gas is high, which accounts for the relatively high value of the carbohydrate-oxygen factor found; while under low light intensity the proportion of oxygen is low, which would result in a correspondingly low factor by the methods employed.

It is undoubtedly true that physiology is more than applied physics and chemistry; yet in endeavoring to ascribe to every effect a discernible cause in a quantitative as well as qualitative sense, it is doubtful whether physiology can find, for the present, more valuable methods and conceptions than are offered by physics and chemistry. This is especially true in the subject of photosynthesis, for which the exact sciences have made available most valuable information during the past few years, and it is only through the application and elaboration of these conceptions that we can hope for a true physiology of photosynthesis.

H. A. SPOEHR

CARMEL-BY-THE-SEA,
CALIFORNIA

LABORATORY APPARATUS AND METHODS

INSTANTANEOUS PHOTOMICROGRAPHY OF THE SKIN CAPILLARIES IN THE LIVING HUMAN BODY

LOMBARD,[1] in 1911, showed that certain capillaries in the human body could be rendered visible under the microscope by adequate illumination. Dr. Mueller and his pupils have extended the usefulness of this method in clinical medicine. Professor Krogh,[2] of the University of Copenhagen, and his colleagues have made very elaborate studies on the anatomy and physiology of capillary circulation. For several years past, Drs. G. E. Brown[3] and H. Z. Giffin[4] and others, of the Medical Research Laboratories of the Mayo Clinic, have been making extensive quantitative clinical studies of the capillaries, as to sizes and blood circulation, both in normal and disease conditions.

In the microscopic study of the physiology of capillaries, the general method of procedure has been to observe visually by the aid of the microscope the changes taking place and the reactions to various experimental procedures. However, no documentary evidence of these observations by means of photographic records has been, in general, possible and, so far as we know, no such documentary evidence exists in the various studies on the capillaries of the living human body. Krogh[5] and others have suc-

[1] Lombard, *American Journal of Physiology*, Vol. xxix, 335, 1911–12.

[2] Krogh, "The Anatomy and Physiology of the Capillaries," New Haven, 1922.

[3] Brown, *American Annals of Clinical Medicine*, Vol. 1, 69, 1922.

[4] Brown and Giffin, *American Journal of Medical Sciences*, Vol. 166, 489, 1923.

[5] Krogh and Rehberg, *American Journal of Physiology*, Vol. lxviii, 153, 1924.

ceeded in obtaining with considerable difficulty photomicrographic records of the capillaries and the circulation in transparent tissues of *Rana temporaria* "at rates varying from 20 photographs per second downwards." Obviously, methods and procedures which would be applicable to the study of the capillaries in transparent tissues of frogs, in which transmitted light could be used, would be of little or no service in obtaining photomicrographs of the capillaries of the human body in from one tenth to one one-hundredth second. For the results obtained in photomicrographing capillaries at the nail-fold, for example, must be dependent on the amount of light which penetrates into the tissues, the portion thereof which is reflected by the capillaries (that is, the contained blood) and which then, in turn, traverses its way through the tissues to the microscope.

As is well known, but little light is needed to make the capillaries microscopically visible to the eye. The problem from the photographic standpoint, however, is much more difficult, due chiefly to the following: (1) inability to get sufficient illumination returned to the plate or film to enable photomicrographs to be obtained in a fraction of a second; (2) with longer exposures, of the order of a few seconds, the difficulty of preventing mechanical movements of the hand or finger, or again of the apparatus used, and (3) should such movements as have been mentioned be eliminated, the impossibility of prevention of slight rhythmic movements due to the pulsations of the heart.

Certain preliminary experiments demonstrated to our satisfaction the uselessness of endeavoring to overcome the difficulties mentioned in (2) and (3), and that success in instantaneous photomicrography of the capillaries in the tissues at the nail-fold would result only through the use of very intense external illumination, so filtered as to remove heat and certain shorter wavelengths of radiation, and directed at such an angle as to throw the light reflected by the surface of the skin out of the direct path of the light reflected by the capillaries and transmitted to the photographic plate or film. Our procedure has been to use as a source of light a 5 ampere direct current arc-lamp, with which to make preliminary visual observations, and, when photographing, to throw suitable resistances in parallel with the fixed resistance for an instant only, permitting 30 to 50 amperes to flow through the arc-lamp. In this manner, both with and without suitable glass and liquid filters, we have been able to obtain satisfactory photomicrographs varying in magnification from 100 to 10 in from one tenth to one one-hundredth second. The contrast has been excellent, the mechanical and rhythmic movements previously mentioned wholly eliminated, and the possibility of an "at-will" photographic record of capillary changes assured. We have also succeeded in making use of an ordinary kodak film, and in taking a series of photomicrographs as desired, approximating a cinematographic record as closely as would ordinarily be desired or of likely service. Further experiments are being carried out on the construction of simple but suitable apparatus for enabling long series of permanent records of capillaries to be taken and kept for measurement and the tabulation of data.

We are informed that various persons have, at different times, made attempts to obtain instantaneous photomicrographs of the capillaries in the living human body, but, in so far as we know, none of these attempts have been successful. Mr. Earl Irish, working in conjunction with Dr. Brown, of this clinic, succeeded about two years ago in getting two fairly good photomicrographs, but the times of exposure were too long and there were evidences of movement. Through the use of the simple procedure we have outlined, practically every photograph is satisfactory and usable for measurements.

We believe that these photomicrographs which we have been able to obtain during the past few weeks are the first photographic records on skin capillaries in the living human body obtained by methods which permit of photographing at will, under normal conditions—for example, without ballooning through the use of a turniquet, and so forth—with good contrast, in any magnification desired, and in from one tenth to one hundredth second, thus ensuring no movements and therefore giving reliability to the data obtained from the measurements of the capillaries.

A reproduction of an "untouched" print made from an original plate in which the magnification is 100 and the time of exposure one tenth second, is enclosed, but I feel that it can not be reproduced to advantage on the paper used in SCIENCE.

The problem of accurate quantitative determinations of the caliber of the capillary loops is wrapped up very intimately with the problem of capillary permeability. It is hoped that these studies will lend additional assistance to the solution of the problems of clinical medicine.

A more detailed account of these experiments and others now in progress will be made later through the channels of medical literature.

I have to thank my assistants, Mr. A. Porter and Mr. R. Halstead, for their aid.

CHARLES SHEARD

SECTION OF PHYSICS,
MAYO CLINIC,
ROCHESTER, MINNESOTA

SPECIAL ARTICLES

THE CIRCULATORY SYSTEM OF THE BRINE SHRIMP[1]

The brine shrimp, *Artemia salina principalis,* has received extensive biological study in the Hopkins Marine Station and the Stanford University under the direction of Professor E. G. Martin. Due to the fact that it lives in sea-salt brines of extreme saturation, it presents numerous problems of peculiar physiological interest. It seems that to date no one has given especial attention to the anatomy and the physiological manifestations of the circulatory organs and tissues of this animal. Artemia lives on unicellular algae and bacteria and its alimentary tract is not clogged with a great deal of opaque material. The tissues themselves are unusually transparent. It is possible to make out the gross and in fact much of the details of the microscope structure by direct inspection of the animal itself under the compound microscope. The following notes are presented for record.

The Anatomy of the Circulatory System

The plan of circulation in Artemia is the open lacunar system, characteristic of crustaceans. However, the anatomical arrangement is much simpler and very much easier of demonstration than in the higher forms, for example, the decapod crustaceans.

The heart: The heart is a simple longitudinal tube, suspended in the body cavity dorsal to the alimentary tract. It is surrounded by open lacunar spaces, being anchored with more or less firmness by the tissue strands from its walls to the alimentary canal and to the body wall.

The heart tube runs the full length of the animal from the caudal segment to the base of the rostrum. It is an exceedingly thin-walled muscular structure. At the extreme posterior end of the heart is a single opening or slit, the caudal ostium. It is guarded by slight enfolding of the lips which operate as valves. The slit of the opening is dorso-ventral, as is that of all the cardiac ostia.

There are bilaterally symmetrical pairs of ostia, from fourteen to fifteen in number, apparently segmental in arrangement, distributed along the sides of the heart tube from the posterior end for two thirds or more of its length. These ostia are guarded by valves as in the case of the terminal or caudal ostium. The walls of the valves are so thin that it requires a medium magnification (x 200–250) to bring them into clearest vision.

There are no ostia along the extreme anterior portion of the cardiac tube. The anterior end of the heart opens freely into sinuses or lacunae at the base of the antennae and eye stalks and adjacent head region. There are no internal cardiac valves.

The lacunar system: There are no blood vessels (Gerstæcker) other than the heart tube, in Artemia. There are certain channels that are well marked and fairly definite. No linings or definite walls of the vascular type were observed. The body cavity and lacunae of the body and appendages are filled with a clear fluid that contains in suspension many nucleated corpuscles. The movements of these corpuscles enables one to follow the outlines of the spaces with remarkable ease. These channels and spaces of the body can be followed out through the appendages—the eye stalks, base of the antennae, limbs, etc. The outlines of the body cavity spaces are much more definite toward the posterior part of the body.

Physiology of the Circulation in Artemia

The body fluid or blood of Artemia is kept in circulation by the interaction of two mechanical factors. First, the pumping of the heart tube and, second, the general body movements, primarily of the appendages.

The contraction of the heart: The straight heart tube contracts rhythmically, with a rapid wave-like movement. The contraction begins at the posterior end and runs in a peristaltic wave toward and over the anterior end. The rhythm at laboratory temperatures and in sea water varies about 125 per minute. The succeeding contraction begins before the preceding one has passed off the tube. The movements of the wafer-thin valves that guard the vertical slits of the pairs of ostia furnish an index of the relative pressures in different parts of the tube and in the adjacent lacunar spaces. This observation is further facilitated by the passing of white corpuscles. Very seldom does one observe corpuscles to move outward through an ostium, or to repass the valves during a peristaltic contraction wave. Occasionally there is a well-marked back and forth movement in the spaces adjacent to the ostia. Even in such instances one could usually observe that the corpuscles had not quite passed the portal of the valve before the peristaltic wave came along.

[1] Professor Ernest G. Martin and Professor Harold Heath, of Stanford University, have made extensive physiological and morphological studies of the west coast Artemia, available in bounteous quantities in Elkhorn slough and adjacent salt beds of the marshes bordering Monterey Bay. This form is a beautiful type for teaching purposes, especially for microscopic demonstration of the open or lacunar plan of circulation. It is remarkably transparent and can be used even under magnifications that reveal cell structure, including muscle striation. It was while preparing material for demonstrating before Dr. Martin's laboratory class in physiology of marine forms that these observations and notes were developed. Since nothing seems available, in the modern literature at least, for the guidance of students of biology these notes are presented. Publication is with Professor Martin's generous consent.

Since there are no valves in the anterior part of the tube and the anterior end is unguarded and freely open into the heart sinuses, it would seem that the forward movement of the blood is the result of differential pressures produced by the passing of peristaltic waves as supported by the valves guarding the ostia. In confirmation of this is the easily observed fact of the pouring in of the blood stream through the ostia during the relaxation stages of the heart tube.

At the wide open anterior end of the cardiac tube the blood flow shows a rhythmic slight backward movement followed by a more pronounced onward rush synchronous with the heart beat. The phenomenon is more clearly observed when accentuated by pressure of the cover slip on an animal mounted in a culture slide.

The blood flow in the body lacunar spaces: The flow in the body cavity and in the appendages is broadly speaking from the cephalic toward the caudal region. But the rate of flow from time to time in particular regions, and to no small extent the direction of flow, varies with the body movements. When the plane of focus is varied between that of the body cavity in the mid-length at the superior surface of the alimentary canal and the slightly deeper plane, blood corpuscles are seen moving along the sides and surface of the gut in a general caudal direction. If a contraction of the digestive tube occurs, then broad fields of corpuscles sweep across the canal surface from one side to the other, now in one direction and now the other.

In the caudal third of the body-cavity well-marked streams of blood are to be observed on each side of the canal that sweep down into the tail lymph spaces and swirl about to enter the lateral as well as the caudal or terminal ostium of the heart. The lateral ostia are clearly marked by entering streams of blood from these two main currénts. One can think of these lacunae as pericardial in type, in the sense in which the term is used in the higher crustacean types—crabs, crayfishes, etc.

The blood flow in the appendages: The outward flow of body fluid into the appendages is in more definite channels, and more rapid and constant, especially in the more anterior pairs—the eye stalks, the antennae and the first two or three pairs of legs. In the leg segments, especially in the so-called respiratory plates, the lacunae often form quite definite capillary-like patterns. The blood can be observed to flow out in the larger of these, usually to one side, and back in adjacent and smaller spaces, sometimes on the opposite side of the appendage. However, in the peripheral regions the flow is often reversed, and varies greatly in speed from time to time in particular spaces. Observing different regions at the same time, the variation in rate of flow in symmetrical appendages is a striking fact. This fact seems largely to depend on the mechanical influence of general body movements.

The activity of the heart, the movements of the respiratory appendages and of the alimentary canal all furnish splendid physiological indexes for interpreting the immediate physiological effects of variations in environmental conditions.

CHAS. W. GREENE

HOPKINS MARINE STATION OF STANFORD UNIVERSITY, PACIFIC GROVE, CALIFORNIA

THE REPRODUCTIVE CYCLE OF THE CHARACEAE

A SINGLE tuft of a very interesting species of *Nitella* (as yet undescribed) was found by me several years ago in a pool on the grounds of this university, and the same species has recently been located in a greater quantity elsewhere in this vicinity. Its most striking peculiarity is that the antheridium is divided into longitudinal quadrants only. I had never felt satisfied with my knowledge of this organ and the mode of its development, and its much greater simplicity in this new species led me to undertake its careful study, as well as that of the oogonium.

I had made some substantial progress in this when my work was interrupted for a few years by circumstances that need not be detailed here. I took it up again last summer and have this year devoted my entire time to it for nearly three months. I have now begun upon a comparative study of a member of the same genus in which the antheridium has the classical division into octants. It is my purpose to follow this with a similar study of species of at least two of the other genera that compose the family of the Characeae. I hope to be able in the near future to publish a detailed account of my results. In the meantime I feel that some of those that I have already obtained will be of interest as throwing light upon this peculiarly aberrant group of plants. They refer, of course, to this particular species.

The first of these is the fact that the plant-body, with its very definite structure, is in the diploid phase (the "2x-generation"), differing in that important respect from any of the Green Algae (as far as we know).

The second, and most important, is the location of the reduction divisions in both the oogonium and the antheridium. This takes place in the apical cell, at a very early stage, in the primordium of each organ. This cell, in the oogonium, soon becomes elongated transversely and assumes an ovoid shape in becoming

the oocyte: it rests directly upon a nodal cell, which gives off the five sheath-cells and then divides no farther, becoming the stalk-cell of the oogonium. By the time the tips of the earlier sheath-cells have reached the level of the oocyte the latter divides at its smaller end, which is directed slightly upward: the new cell, which is soon separated by a distinct wall, is the first polar body. Very soon after the nucleus of the oocyte divides again in a direction at right angles to the first division, that is, downward and slightly to one side, and the new cell is separated by a distinct wall; it is the second polar body. The new "mature" ovum soon elongates vertically, its nucleus assuming its characteristic position near the base.

The rapid enlargement of the ovum and the inward pressure of the upper ends of the sheath-cells (which have already begun to form the corona) cause the first polar body to move toward the base: on its way it sooner or later divides to form the two secondary polar bodies. This completes the formation of the three famous "wendungszellen" (which, as will be seen, are *not* formed by three successive divisions of the oocyte).

In the antheridial primordium the apical cell early becomes swollen and elongated. The nucleus then divides in a horizontal plane: and this is immediately followed by a second division in the same plane, but at right angles to the first: both divisions take place before any indication of parting walls are seen, the four resulting "resting" nuclei being located in a horizontal group at equal distances from each other in the cytoplasm of the single enlarged mother-cell. The longitudinal parting walls soon follow, thus completing the formation of the quadrant cells. This is the reduction division; and all that now follows is in the haploid phase (the "x-generation"). The further development of the antheridium shows in this species some interesting features that have not yet been noted, but I will not discuss them here, except to say that in this species the total number of spermatic filaments does not exceed sixteen, two being given off by each of the four capitula, and two from each of the four capitella. This can be clearly seen until the filaments become so long and so much intermingled as to fill the entire cavity and hide the basal cells from sight. No branching of the filaments has been observed.

The counting of the chromosomes is very difficult, owing to their small size and their crowding in the very small mitotic figures. Repeated counts, which have in most cases been independently corroborated by colleagues familiar with such work, give 15 (or 16) for the haploid and 30 (or 32) for the diploid phase.

This preliminary notice has been published for two reasons. The first of these (as has been already indicated) is that it may be of interest and service to those who desire to know more about this unique group of plants. The second is that, for the comparative study that I purpose to make, I am in need of material and of assistance in obtaining it. I am very desirous of obtaining well-fixed material of any dioecious species of *Nitella*. One species of *Chara* I have located in an adjoining county; but I should be glad to have other species. I am particularly desirous to get some good material of *Tolypella*, which I have not yet been able to find, here or elsewhere. I should be more than glad to see and study plants of either of the three remaining genera of the family, but they are very rare. Any one, therefore, who can conveniently help me to obtain well-fixed material of either of the three principal genera of the group will do me a great kindness.

It is now probably too late for securing good material in which the formation of the reproductive structures is still going on, except in the more southern regions of this country. I hope, however, that this request for assistance will be borne in mind next season by some of those living in more northern regions where such material can then be obtained.

A few words regarding its preparation. It is essential that the fixing solution be carried to the place of collection and the plants (or tips of large plants) put into it at once. Any good fixing mixture that penetrates (and therefore kills) quickly will serve. Thorough washing should be at once followed by successive alcohols up to 70 per cent.

The material should then be sent by express at my expense to me at the address given below.

ALBERT H. TUTTLE

BIOLOGICAL LABORATORY,
UNIVERSITY OF VIRGINIA,
CHARLOTTESVILLE, VA.

THE PLASTICITY SYMPOSIUM AT LAFAYETTE COLLEGE

PROGRAM of the Plasticity Symposium held at Lafayette College on October 17, Professor Harry N. Holmes, presiding.

Introduction: EUGENE C. BINGHAM, Lafayette College.

Emulsions: HARRY N. HOLMES, Oberlin College.

The plasticity of single crystals as related to their crystal structure: WHEELER P. DAVEY, General Electric Research Laboratory.

The plasticity of clay: WILDER D. BANCROFT and LEON E. JENKS, Cornell University.

The Ostwald viscometer as a consistometer: WINSLOW H. HERSCHEL, United States Bureau of Standards.

Plasticity in relation to gelatine: S. E. SHEPPARD, Eastman Kodak Company Research Laboratory.

Plasticity in relation to glue: Robert H. Bogue, Portland Cement Association Research Laboratory.

Plasticity as applying to viscose and artificial silk: Charles S. Venable, The Viscose Company Research Laboratory.

Plasticity in relation to cellulose and cellulose derivatives: S. E. Sheppard, Eastman Kodak Company Research Laboratory.

The plasticity of starch: Carl Bergquist, Corn Products Refining Company Research Laboratory.

Plasticity as applied to blood and other physiologic systems: I. Newton Kugelmass, Yale University Medical School.

What the paint and rubber technologist wants in plasticity measurements: Frank G. Breyer, New Jersey Zinc Company Research Laboratory.

The plasticity of dental compounds: Walter S. Crowell and Albert Saunders, Jr., S. S. White Dental Company Research Laboratory.

A simple plastometer for control use with dental creams: E. Moness and P. M. Giesy, Brooklyn Research Laboratory, E. R. Squibb and Sons.

THE ILLUMINATING ENGINEERING SOCIETY

The program of the eighteenth annual convention of the Illuminating Engineering Society held at Briarcliff Manor, New York, from October 27 to 30, was as follows:

Monday, October 27

Morning

Registration.

Afternoon

Address of Welcome, Hon. Frank L. Young.

Response to Address of Welcome, L. B. Marks.

President's Address, Clarence L. Law.

General Secretary's Report, Norman D. Macdonald.

Report of Committee on Progress, F. E. Cady.

Report of Committee on Motor Vehicle Lighting, Dr. Clayton H. Sharp.

Report of Committee on Nomenclature and Standards, E. C. Crittenden.

Report of Committee on Research, M. Luckiesh.

Report of Committee on Lighting Legislation, L. B. Marks.

Tuesday, October 28

Morning

Predetermination of daylight from vertical windows: H. H. Higbie.

Report of committee on sky brightness—a Symposium on Daylight Recording:

Records of total solar radiation intensity and their relation to daylight intensity: H. H. Kimball.

Records of daylight by the photoelectric cell: James E. Ives.

Daylight recording by the New York Edison Company: Walter R. Boyd.

Daylight recording by the Edison Electric Illuminating Company of Boston: H. J. Baker.

The chromograph: H. Logan.

Afternoon

Session at the Boyce Thompson Institute for Plant Research—a symposium on the Effect of Light on Plant Growth:

Summary of literature on the various phases of the effect of light on plant growth: Henry W. Popp.

Work to date at the Boyce Thompson Institute for plant research on light: John M. Arthur.

Discussion of work to date and its applications: Dr. William Crocker.

Influence of colored light on plant growth: Samuel G. Hibben.

Stimulation of plant growth by means of electric lighting: Victor A. Tiedjens.

Tour of the institute and inspection of constant-light room in auxiliary lighted greenhouses and other equipment.

Wednesday, October 29

Morning

High intensity illumination at the McGraw-Hill Publishing Company's Plant: Harold V. Bozell.

Display-case lighting in stores: J. L. Stair and Wm. Foulks.

Daytime illumination in show windows: Ward Harrison and Walter Sturrock.

Periodic eye examinations in a testing laboratory: Norman D. Macdonald and Dr. James W. Smith.

The ocular principles in lighting: C. E. Ferree and G. Rand.

Evening

Decorative and theatrical lighting: Claude Bragdon.

Toward a closer cooperation between producer and engineer in motion picture lighting: Wiard B. Ihnen and D. W. Atwater.

Thursday, October 30

Morning

A survey of street lighting practice in the United States: J. Franklin Meyer.

Some results of the Columbus street lighting tests: F. C. Caldwell.

Traffic control systems: C. A. B. Halvorson, Jr.

Short cut design for electrical advertising: C. A. Atherton.

Report of Committee on Educational Courses.

Afternoon

The meaning of speed of vision: Percy W. Cobb.

The connection between astronomical and practical photometry: Professor Chas. Fabry, University of Paris.

Glare and visibility: M. Luckiesh and L. L. Holladay.

Is a new class of membership desirable? Preston S. Millar.

The luminous efficiency of "cold light": Elliot Q. Adams.

Friday, October 31

Morning

Section development meeting under the direction of President Crittenden.

SCIENCE

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T. MITCHELL PRUDDEN, 1849–1924

Dr. T. Mitchell Prudden was one of the group of advisers of Mr. Rockefeller and his associates consulted on the creation of an institution for the investigation of disease, and he became one of the original members of the scientific board to which was entrusted the conduct of The Rockefeller Institute for Medical Research when founded in 1901. Dr. Prudden was chosen first vice-president of the board and first chairman of its executive committee, offices which he continued to hold until his recent death. Although repeatedly pressed to accept the presidency of the board, he resolutely refused the election. The services rendered to the institute by Dr. Prudden far exceeded in scope and devotion the official positions which he held.

Dr. Prudden's professional life in New York covered more than forty years, and was spent in large measure in forwarding the public welfare. But so self-effacing was he that it was only to his family, intimate friends and a coterie of his professional associates that the nature, variety and extent of his public services became known. The aid he rendered to the departments of health of the city and state of New York is written large in their history; as a student and teacher of cellular pathology and bacteriology—two branches to which modern medicine owes very much of its recent advances—he ranks among the leaders; and many of his pupils now carry on the high standards and wholesome traditions which he helped to establish in the country. After his retirement from the professorship of pathology at Columbia University in 1909, Dr. Prudden continued to exercise his humanitarian impulses and his interest in medical research in connection with the public health council of the state department of health, of which body he was an original member, and with the Rockefeller Institute to which he came daily and participated in many of its activities. To his many other gifts, Dr. Prudden added an exceptional administrative capacity and executive acumen. Hence he served many important enterprises of philanthropic and scientific nature during their formative and stressful periods in a manner which contributed valuably to their ultimate successful issue.

Dr. Prudden possessed a natural habit remarkably straightforward and elevated. It is doubtful whether many persons casually penetrated an exterior superficially somewhat austere. But to the number, by no means small, of persons admitted into the inner circle of his personality, he exhibited a nature peculiarly sympathetic, sensitive and simple and a heart of rare

warmth and richness. His scientific ideals were high, sometimes it seemed almost unapproachably high. And yet he produced work of his own, through his pupils and by stimulation from many others; and no one put a higher value on something real achieved than did Dr. Prudden.

Fortunately, Dr. Prudden has left behind materials suitable for a brief sketch of the outstanding incidents of his life, for the use of which I am indebted to his sister, Miss Lillian E. Prudden.

T. Mitchell Prudden was the fourth son, in a family of four sons and one daughter, of the Reverend George Peter Prudden and Eliza Ann Johnson. The father, a Congregational clergyman, was the direct descendant, seventh generation, of Reverend Peter Prudden, one of the founders of New Haven colony in 1638. It is of some interest to record that the Reverend Peter Prudden later separated from the New Haven colony and established the Milford Church in 1639.

Dr. Prudden was born in the parsonage at Middlebury, Connecticut, on July 7, 1849. He died in New York City on April 10, 1924. His early life was passed in the parsonages at Middlebury, Southbury and Watertown, Connecticut; for a brief period on a farm belonging to the family, and at New Haven, Connecticut; the last 45 years were spent in New York. The early period is made up of the common heritage, varied only by circumstance, of healthy and happy childhood. One point is stressed, namely, that in the household there existed "sympathetic realization of the youngster's point of view, and for the necessity of amusement and initiation into knowledge and familiarity with things worth while." The strenuous period with many vicissitudes came with adolescence; the father's anti-slavery proclivities aroused vehement opposition, which in turn served to accelerate a decline of health already apparent, and this led to his retirement from the pulpit, although for a time preaching was continued in other places. The eldest son, Henry, of strong literary tastes and an eager desire for a college education, "courageously and generously" entered business in New Haven and later prospered. In 1866, when Mitchell was 17, a place was found for him in Henry's establishment, where, besides sweeping and dusting, he was initiated into the vagaries of salesmanship and the intricacies of bookkeeping. The duties proving irksome and the youth perhaps ill adapted, the connection was dissolved and a year or more later, after a period of indefinite happenings, Mitchell embarked upon his first real adventure—an index perhaps of many subsequent ones pursued in Europe and in this country in wooing the new cellular pathology and bacteriology and harnessing them to an outworn and changing medical creed, and in explorations of the Great Western Plateau. This first venture included a cruise in Long Island Sound in a Menhaden fishing schooner, a mutiny among the crew, the landing of the passengers on the rocks at Stratford Light and a walk back to New Haven.

In 1866 the start, with the financial backing of Henry, was made towards college and the sciences. A preliminary year was spent at Wilbraham Academy, and the Sheffield Scientific School was entered in 1869 under a Connecticut state fellowship which provided free tuition during the undergraduate years. The first year courses in physics, chemistry, mathematics, German and English were followed and the goal of medicine was decided upon. As there was at that time no combined instruction provided in zoology, botany, organic and physiological chemistry, Prudden and his friend Russell, who already sensed their importance for a medical career, appealed to the faculty with such success that a course called "The biological course in preparation for medicine" was instituted. The class started with the two friends as sole attendants. This proved no disadvantage, as the earnest young men "were invited for special, advanced work in botany into Eaton's herbarium at his house; they were placed in Johnson's private laboratory for physiological chemistry; they worked rather as assistants than as students under the eye . . . of Verrill and Sid. Smith in the old 'Bug Lab' (alias zoological laboratory)." The two concluding years were full of action: the collection of plants and animals; scouring of land and sea about New Haven; studies with Whitney, Lounsbury and Gilman—all combining to arouse a profound and abiding interest in the now aspiring Mitchell. In view of the facile pen which he later wielded, it is interesting to note that Prudden received honorable mention in English composition under Lounsbury.

It was in the last spring vacation of 1872 that Prudden and Russell chartered a yacht and "taking along a few choice spirits, made a week's dredging expedition down the Sound. They dredged off Watch Hill and Newport, went over to Holmes' Hole (Woods Hole), Edgartown, had a glorious adventure, and brought back much plunder, establishing new habitats for several marine invertebrates. . . . This was the first dredging done about Woods Hole and its neighboring waters."

Progress had now come with celerity. During the last term in the Sheffield Scientific School, Prudden was selected to substitute for Professor Mixter in freshman elementary chemistry. "There were weekly lectures with an experimental lecture, a practicum for the whole class once a week, and recitations." Study had also been begun at the Yale Medical School under the old two-year lecture system; and, at the same time, Prudden served as secretary to the faculty of the Scientific School. The M.D. degree was awarded in the autumn of 1875, the spring

months having been spent in New York in the study of pathology under Dr. Francis Delafield. A hospital interne year, divided between medicine and surgery, followed at the New Haven Hospital. As the hospital did not then provide a laboratory for clinical tests, Prudden brought his New York experience to bear by setting up a small one in a basement room. It should now be apparent to one looking backward over Prudden's career that the laboratory instruction at the Sheffield Scientific School served to discontent him with the system of didactic lectures in vogue at the Yale Medical School, and drove him to study pathology under Delafield in New York, which experience in turn determined his going abroad for further training and thus had much to do in shaping his subsequent course.

The lack of opportunity to pursue adequately practical laboratory courses of instruction in the fundamental branches of medical science in the United States led Prudden, immediately after the completion of his interneship, to seek this opportunity abroad. He naturally turned toward Germany and chose Arnold and Heidelberg as his immediate goal. There still exists the letter, dated September 10, 1876, in which Professor Arnold informs Prudden that a place had been reserved for him in his laboratory and that he does not accept fees. He, however, states that a registration fee of about 10 marks is required. During the winter semester, therefore, of 1876–1877 Prudden followed the lectures and laboratory courses under Professor Arnold and his associate, Dr. Thoma. Subsequently he visited other medical centers, including Vienna, and worked in other laboratories, returning to New Haven after a period of two years of study abroad.

In 1879 there appeared in Virchow's Archiv the paper, "Beobachtungen am lebenden Knorpel," which embodied the results of the main laboratory study pursued by Prudden under Arnold's and Thoma's direction. The study is perhaps more significant to-day than it was at that time. In brief, it represents the endeavor to trace the effects of injurious agencies on living cells while still under control of normal environmental conditions. The fixed cells of the episternal cartilage of the frog were the objects chosen for observation and experiment. A clever device was arranged by which that quite transparent structure could be viewed for hours directly under the microscope, while still in vascular connection with adjacent parts. The chromatin network of the nucleus was discerned and shown to be a preformed structure; variations in cell forms and content, inducible at will, were seen to appear and disappear according to the influences to which the tissue was subjected; the important fact that dissolved dyes do not color the living, but do stain the dead nuclei, was clearly shown, as was the fact that it is particulate, not dissolved dyes, which are ingested by living cells. Just now when the growth of cells *in vitro* is affording so remarkable an opportunity to unravel the intricacies of cell generation and degeneration, and vital staining is clearing up so many dark and disputed questions of cell origin and fate, this early, spirited investigation of Prudden may be regarded as a pioneer undertaking in observing what actually goes on in living cells as distinguished from the inferences drawn of the processes concerned, from the appearance of dead tissues, fixed in chemicals and stained in section. Prudden sums up his findings in the following important paragraph:

> But it seems to me particularly significant that it is possible to observe under the microscope, on living cartilage tissue, the processes of contraction and the formation of vacuoles; and that it is possible thus to determine whether and under what conditions such changed cells return to the normal state or whether they undergo degeneration and die. The observations made with reference to the behavior of living and of dead cartilage cells in response to dyes also seem to me noteworthy, because we thus learn that only the nuclei of the latter stain homogeneously. We are, therefore, in a position to distinguish whether cells are dead or living, and can thus exclude their participation in regenerative processes.

It was in 1879 also that Prudden abandoned the idea of the practice of medicine and adopted the career of full-time teacher of pathology in New York. This momentous decision was not something made without forethought and perturbation of spirit.

> When Prudden came home from Europe, full of enthusiasm to introduce into the lore and training of medicine the laboratory and special research study and teaching of normal histology, pathology and pathological physiology, as related to medicine, with all of which he had been especially engaged in various places during his two years abroad, he was chagrined to find none of the authorities at the several medical schools whom he consulted and the few leading practitioners of medicine with whom he talked, seemed to care about these things as special subjects of knowledge or training. There were chairs of pathology and the practice of medicine, but no chairs of pathology as a special practical theme, and no one saw any occasion to establish them. . . . Thus it was that after vain efforts to get a place to work at pathology at any of the medical schools, even as a volunteer, Prudden finally came back to New Haven, opened an office and started to practice.

However, beneath this placid surface of complacence in the medical schools, with things as they are, a new movement was beginning to make itself felt. Dr. Welch had recently become established at Bellevue Hospital Medical College in a laboratory adjoining the dead house at Bellevue Hospital and was attracting students to his demonstrations and lectures from all three medical schools in the city. This notable

success led the Alumni Association of the College of Physicians and Surgeons to propose to set up a pathological laboratory, and Dr. Delafield turned to Prudden, to whom was offered the position as assistant.

The letter (Delafield's) was carefully weighed as the turning point in an opening career, and finally the offer was declined. The letter expressed regret that financial and other circumstances did not seem to justify the writer in cutting adrift from his old associates and a modest living as a teacher and practitioner in New Haven. . . .

This letter ready for posting was held over until morning. During the watches of the night, however, the spirit of adventure, or the lead of a strong impulse of devotion to the advancement of science, led to the destruction of the letter and an acceptance of Delafield's offer and the arrangement of a visit to New York.

This momentous decision, not only for Prudden himself, but, as it proved, for the future welfare of pathology in the United States, was communicated promptly, it would appear, to Professor Arnold, since in a letter from him dated November 15, 1878, I glean the following:

Your letter pleased me greatly because I am convinced that the position you have assumed will assure you a future. From my knowledge of you, I am, I believe, justified in saying that you will not now easily be diverted from the goal of a scientific career. There is no doubt in my mind that your institute will be a success. The fact that it is small and has only moderate means at its disposal is not important. Some time ago, our German pathological institutes, with the exception of a few, were very bad; now they are being replaced by good ones. But I know from personal experience it is possible to work in even a small institute.

All that Professor Arnold prophesied came true, even to the lean years and the apathy on the part of the older practitioners and teachers in the medical school. But when the College of Physicians and Surgeons was built on West Fifty-ninth Street, opposite the Roosevelt Hospital and adjoining the Vanderbilt Clinic, its chief glory consisted of the splendid group of laboratories, long unequalled, housing the significant department of pathology and bacteriology presided over by Dr. Prudden.

But in 1878–1879, when these beginnings were being laboriously and painfully made, there existed in English no text-book which fairly represented the subject of pathological anatomy as conceived and taught in Europe, especially in Germany. Prudden conceived the notion, even before he returned from his European trip, of translating the brief but excellent work of Perls, and with this end in view, he carried on a correspondence with the author, whose consent he obtained, and then with American publishers, who declined to undertake the printing. From his letter to Professor Perls, ending the series, I abstract the following:

I have been delayed in writing to you, as I promised before leaving Germany, on account of the tardiness of several publishers in answering my communications.

I regret to inform you that none of our best publishers in New York or Philadelphia are willing to undertake the publication of the work at present. The times are bad and the pathological works which have been translated have not been financially successful, and hence they are unwilling to assume this responsibility now.

I regret extremely that it can not be added to our English works at once. I think it possible that it may be done after a time, but at present it seems impossible.

But the large gap which Prudden tried unsuccessfully to fill at the outset of his career with the translation of Perl's pathology he was destined to fill later with a more ambitious and significant work of his own with Delafield. The first edition of Delafield and Prudden's text-book appeared in 1885. As an index of the change in sentiment regarding pathology which had taken place in half a dozen years in America and the standing it came to have may be cited the fact that a second edition was called for within the year. Twelve editions have now been published, each more complete and comprehensive than its predecessor. There is not a modern student or practitioner of medicine who has not fed on its authoritative contents. Dr. Delafield dropped out of the work as part author after the seventh edition. From the tenth edition on, Dr. Francis C. Wood, a pupil of Prudden's, has cooperated in preparing the new volumes. The work as a whole is a tribute to Prudden's grasp of the principles and the practical details of general and special pathology and bacteriology; and among its distinguishing characteristics are charm of style and precision of language, which only felicity and mastery of English diction could achieve.

The great wave of interest in bacteriology, set in motion by the remarkable work of Pasteur and of Koch, and which broke over the world with the announcement of the discovery of the microbes of tuberculosis, cholera, typhoid fever and of the means of preventing rabies, led to a quick response from Prudden who sensed the part the new science would come to play in pathology and in preventive medicine. Early in 1885, therefore, he planned to return to Germany to study, if possible, under the master Koch himself. That he at once enlisted the good offices of his old teacher in this ambition is shown by a letter under date of March 29, enclosing a note from Koch himself, written by Professor Arnold. Koch's note states that "at the moment it is not possible to accede to the request of Dr. Prudden, as the few available places at the Gesundheitsamt have already been assigned for some time ahead." He adds that "a hy-

gienic laboratory will be opened within the next few months, and I expect to give a bacteriological course there. I would suggest informing Dr. Prudden of this opportunity." Arnold's covering letter to this significant enclosure suggests that a preliminary course be taken with Heuppe in Wiesbaden or Frobenius in Munich. He adds, "I was delighted with your letter, because I gather from it that everything is going well with you, and because you give me the hope of seeing you soon." That Prudden's desire to study under Koch was finally achieved is shown by a paper, written in 1885, in which he describes the method of teaching carried out by him.

Thus the course in the study of bacteria, of one month's duration, in Koch's laboratory was brought to an end, and the writer can not refrain from remarking that the calm, judicial mind of Dr. Koch—the master worker in his field—his marvelous skill and patience as an experimenter, his wide range of knowledge and his modest, unassuming presentation of his views are all calculated to inspire confidence in the results of his own work, to stimulate his students to personal exertion in this field and to lend certainty to the already widespread hope that ere long through the resources of science we shall be able to cope successfully with those most terrible and fatal enemies of the human race—the acute infectious diseases.

Prudden became, therefore, the instrumentality through which the new bacteriology was brought to New York; research was begun and courses of instruction in the subject were at once offered to students; and the tenets of the new science were made practically potent through the influence which Prudden exerted upon the officials of the city department of health and by a well-considered newspaper campaign carried out anonymously over a period of years. It is no accident, therefore, that the department of health of New York presented itself as well advanced in applying to public health measures the teachings of the new hygiene.

The large range of Dr. Prudden's intellectual activities can be gleaned most easily from the list of his published papers and books which, from 1879 to 1914, cover about 100 major titles. The greater number of the papers and books relate naturally to his special field of inquiry, namely, pathology and bacteriology, in the widest sense. The articles and books on American ethnology form a thing apart and show how readily Prudden might have led in archeology, as he did in pathology. His pen was a facile instrument which he could turn at will to the description of detailed and abstruse phenomena or the revealing of fascinating and romantic happenings in the life of the bacteria, the conquest of disease, the past of American aborigines, or indeed any theme which engaged his interest and his thought. His delightful booklets, "The Story of the Bacteria" and "Dust and Disease," were more than messengers of light to the medical profession; they were written in such simple and delightful style that they were read with the absorption of romance by many lay persons, and contributed a large share to that popularization of authentic knowledge upon which the modern practice of sanitation has come to be built. But, as with every scientific man, the most enduring productions are the results of his own efforts to extend the bounds of knowledge; and in that endeavor, Dr. Prudden himself labored through many years and inspired the labors of many others. There stand to his credit and that of his pupils many conspicuous pieces of finished work.

The adventurous and pioneer Prudden did not fail after arduous days to bring back his ship laden with a rich freight of humanitarianism and science. Let this be his monument.

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VASECTOMY AND REJUVENESCENCE

THE skepticism manifested by many biologists concerning the results of vas deferens ligation or vasectomy in producing rejuvenating effects seems abundantly justified from both old and new researches. The Steinach operation has commanded considerable interest because of its rejuvenescence claims, *i.e.,* by the remarkable character of these reported effects of restoring youthful vigor. The explanation usually offered is to the effect that there is produced degeneration of the spermatogenic cells with attendant hypertrophy of interstitial tissue. The latter supposedly causes the rejuvenescence. The primary atrophy of the spermatogenic cells is said to be followed by a subsequent regeneration which relieves the animal of the temporary sterility produced by the ligation.

A review of the literature on vasectomy which has been accumulated since the early eighteen hundreds is especially interesting. Hunter,[1] Cooper,[2] Gosselin[3] and Curling[4] were among the earliest of those interested in pathological change in the testes, epididymis and vas deferens. Part of their interest lay purely in the field of pathological findings together with a

[1] Hunter, "Hunter's Works," Ed. by Palmer, Phila., 1841.

[2] Cooper, "Observations on the Structures and Diseases of the Testis." London, 1845.

[3] Gosselin, Arch. gen. de Med., 1847, S. 4, Vol. XIV, p. 408; "Nouvelles Études sur l'obliteration des voies spermatiques et sur la stérilité consecutive à 'l'épididymite bilaterale." Arch. gen. de Med., S. 5, Vol. II, p. 256.

[4] Curling, "On the Diseases of the Testis," Phila. 1866.

speculative interest in the consequences to the testes of the absence of the vas deferens or of its occlusion. This interest is typified in Curling's experiments upon three dogs and one cat. He found that vasectomy of sixty days to eight months was followed by distension of the epididymis with testicular products, including spermatozoa, and that no changes took place in the testicle proper. Such experiments were looked upon as confirmation of observations made from human dissections where the vas deferens was either prenatally absent or had been occluded for a long time with no marked effect upon the testis. Curling cites a number of such dissections in his book on "Diseases of the Testis."

A little later this interest was increased in an endeavor to find a relief for pathological hypertrophy of the prostate. Some of the earlier workers referred to above were interested in this phase of the study, but the writings of Spangaro and of Wallace are especially to this point. Spangaro[5] found spermatozoa in the testes of three men, twelve days, six months and two and one half years after vasectomy, while Wallace[6] concluded from a review of literature and from a series of experiments on six dogs and one kitten that the growth of the testicle and its function of producing spermatozoa is independent of the integrity of its vas.

Experimental biologists had likewise pursued this line of investigation and had obtained similar results. Brissaud[7] used rabbits as experimental material and found that the epididymis became enlarged because of the accumulation in it of spermatozoa which the testis continued to produce. Shattock and Seligman[8] found that vasectomy on sheep for a period of a year or more produced no degenerative effects in the testes. We thus find in the literature up to this time a general and remarkable unity of results. These early workers found that occlusion of the vas deferens produced no pathological changes in the testis proper. The reader should note the diversity of material studied: rabbits, cats, dogs and human tissue.

At about this same period two French biologists, Ancel and Bouin,[9] using rabbits as experimental material, reported that degeneration of spermatogenic tissue always took place if the ligation was continued long enough. They supported their contentions by studies on cryptorchid testes of pigs and showed that the vasectomized and cryptorchid testes were almost identical. These experiments were used by Ancel and Bouin as a link in their proof that the interstitial cells produced the testicular hormone. Steinach confirmed and extended these experiments, claiming to produce by them rejuvenescence. He used rats as experimental material and claimed that when old, senescent animals were vasectomized they showed definite signs of rejuvenescence within twenty-one days. He contended, as did Ancel and Bouin, that the spermatogenic tissue of vasectomized testes underwent degeneration, while the interstitial cells hypertrophied. He then argued that sex activity increased through the enlargement of the "puberty gland"—the interstitial cells. Sand, Tiedje and Lipschutz quickly took up this work on rabbits, rats and guinea pigs. These men, as did Steinach, found degenerative changes in *some* testes, while *in other cases the testes were normal.* Steinach[10] and Tiedje[11] explained these irregularities by stating that degeneration always took place, but that after some time regeneration followed. Sand[12] and Lipschutz[13] explained the irregularities in their experiments by stating that some of the animals used were immature when operated upon and that these alone did not suffer degeneration of the germinal tissue. It is interesting to note that in one report by Sand,[14] in which he presents fifteen vasectomy experiments only two had degenerated testes.

Most of these workers were ignorant of the earlier work or deliberately ignored it. Beginning with Ancel and Bouin, they all used rodents in their ex-

5 Spangaro, "Nel Testicolo Senile conduce la ligatura del dotto deferente all' atrofia dell' orgeno?" *Lo Spermintale,* 1903, an 57, F3.

6 Wallace, "The results of castration and vasectomy upon the prostate gland in the enlarged and normal condition." Trans. Path. Soc. of London, 1905, Vol. LVI, p. 80.

7 Brissaud, "Effects de le Ligature du Canal Deferent," Arch. d. Physiol., S. 2, Vol. VII, p. 769.

8 Shattock and Seligman, "Observations upon the acquirement of secondary sexual characters, indicating the formation of an internal secretion by the testicle," Proc. Royal Soc. of London, 1904, Vol. LXXIII, p. 49.

9 Ancel and Bouin, "Recherches sur les Cellules Interstitielles du Testicule des Mammifères," Arch. d. Zool. Exper., 1903, S. 4, Vol. 1, p. 437.

10 Steinach, "Verjungung durch experimentalle Neubelebung der alternden Pubertatsdruse." Arch. f. Entwickmeck, 1921, Vol. XLVI, p. 557.

11 Tiedje, "Changes in testes after ligation." *Deutsch. Med. Wockenschr.,* 1921, Vol. XLVII, p. 352.

12 Sand, "Études exper. sur les glandes sexuelles chez les mammifères," *Journ. of Physiol.* 1921, XIX, pp. 305, 494 and 515.

13 Lipschutz, "The so-called compensatory hypertrophy of the testicle after unilateral castration." *Journ. of Physiol.,* 1921, Vol. LV, p. 451.

14 Sand, "Expériences sur la resection du vas deferens," *J. de Physiol. et de path. gen.,* 1923, XIX, 494–503.

periments. It remained for the writer to show that their choice of experimental animals was particularly unfortunate (Oslund).[15] In these animals (rodents) the testes are free to move from the scrotum into the peritoneal cavity and vice versa. Following ligation or resection of the vas deferens, the testes are often retained in the peritoneal cavity by adhesions. It is this artificial cryptorchidism that causes degeneration of the germinal epithelium. Vasectomy alone does not cause such degenerative changes. In order to carefully test this point several extensive series of experiments of from fourteen days' to ten months' duration were performed upon rats and guinea pigs. Degeneration of the germinal epithelium did not follow ligation of the vas deferens in any experiment of short or long duration where the testes were known to reside in the scrotum following the operation. Degeneration did take place in every experiment where the testes, either uninjured or vasectomized, were retained in the peritoneal cavity.

In a later paper it was shown that vasectomy on dogs does not produce degenerative changes in the testis or hypertrophy of interstitial cells (Oslund).[16] In rodents the inguinal canal is patent, while in carnivora it is closed and vasectomy results are not complicated by the possibility of accidental cryptorchidism produced by the operation. Care was taken to eliminate all extraneous factors, such as diet and confinement. Following closure of the vas deferens, there is an accumulation of testicular products in the epididymis which leads to its distension. An equilibrium between rate of spermatogenesis and absorption of this material is quickly reached, and no degeneration of seminiferous tubules takes place.

A detailed review of the literature bearing upon vasectomy on animals having a closed inguinal canal strikingly emphasized the above points. From such a review it has been pointed out that vasectomy on sheep from seventy-six days to one year, on dogs from sixty days to four years and on man from twelve days to four years has produced no testicular changes (Oslund,[16] p. 117).

What, then, of interstitial cell, "puberty gland," hypertrophy? In a recent paper it has been shown that unless there is degeneration of the germinal epithelium, interstitial cell hypertrophy does not take place (Oslund).[17] The interstitial cells occupy the spaces between the seminiferous tubules. Only when these tubules atrophy are these spaces increased in size. It is then quite evident that increase in interstitial cell mass, either in cell number or in cell size, can take place only when these tubules atrophy. When an increase of interstitial cells takes place it is largely regulated by tension and pressure within the testis. Compensatory hypertrophy of interstitial cells is very probably a misnomer and not a reality (Oslund,[17] p. 595).

It then appears that vasectomy causes no changes in the testicle proper. The epididymis becomes somewhat distended with testicular products. There results no degeneration of germinal epithelium and no interstitial cell hypertrophy. The changes claimed to have resulted from vasectomy appear to have been produced by subsequent influences rather than by vasectomy itself.

The theory of rejuvenescence at present is based upon a necessary interstitial cell hypertrophy. Ligation of the vas deferens does not produce such a hypertrophy. Vasectomy, therefore, can not be looked upon as a method of causing rejuvenescence

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15 Oslund, "Vasectomy on rats and guinea pigs," *Am. J. of Physiol.*, 1924, Vol. LXVIII, p. 422.

16 Oslund, "Vasectomy on dogs," *Am. J. of Physiol.*, 1924, Vol. LXX, p. 111.

17 Oslund, "Interstitial cell hypertrophy," *Am. J. Physiol.*, 1924, Vol. LXIX, p. 589.

THE HARVARD SUMMER SCHOOL OF GEOLOGY

RECENT mention in SCIENCE (August 22, 1924) of the summer school of geology being conducted by Professor Grant, of Northwestern University, moves the undersigned to offer the following account of the Harvard school which was held under Professor Shaler, in camp, on Cumberland Mountain, near Cumberland Gap, on the Kentucky side, in June, July, August and September, 1875. This antedates Professor Grant's camping school 49 years and shows that the idea of a camping school of geology is not new in this country. The names of some prominent men connected with this school or who have since become prominent, especially in science, and some personal reminiscences may not be without interest.

The writer, born within ten miles of the first pig-iron furnace in America, on the trail left by Spotswood and the Knights of the Golden Horseshoe, after leaving the Virginia Military Institute, Lexington, Virginia, reached Kentucky on St. Patrick's day, 1874, when Professor Nathaniel Southgate Shaler, of Newport, Ky., and Harvard College, was directing the reinstated Kentucky Geological Survey begun by David Dale Owen in the early fifties. Professor Shaler conceived the idea of holding the Harvard summer school of geology in connection with the work of the survey the next summer.

Camp Harvard, on the Harlan C. H. road, at the foot of the Pinnacle, some mile or more west of Cum-

berland Gap, was reached on July 4 of that year. In the party there were some 15 or 20 Harvard students who reached Norfolk, Virginia, by water, thence to Morristown, East Tennessee, then on foot to the camp.

The officers of the camp (all members of the Kentucky Geological Survey) were Professor N. S. Shaler, state geologist, Jno. R. Proctor, camp master, Philip N. Moore, of Missouri, geologist, Chas. J. Norwood, of the same state, geologist, A. R. Crandall, of New York and Wisconsin, geologist, Lucien Carr, of St. Louis, archeologist, J. H. Talbutt, Lexington, Kentucky, chemist, and James Mullen, of Lexington, Kentucky, photographer. Colonel W. C. P. Breckinridge, wife and family of four children, together with Mrs. Pickett and Misses Desha and Kinkead, were with us for the summer. With us also were Professor Shaler's wife and little daughter, and Mrs. A. R. Crandall, also Colonel Gordon McKay, millionaire of Boston, inventor and patentee of the McKay stitch, and Hon. John D. White and sister. The school was 40 miles from a railroad, on the east or Tennessee side, and 75 on the west or Kentucky side; almost entirely inaccessible by means of wheeled vehicles, but wonderfully located for the study of geology, as there was immediately by an exposure from the Upper Coal Measures to the Potsdam Sandstone, finely exposed, with faults, anticlines, synclines, etc., well displayed. There were between 30 and 35 men, the majority of whom were students under Shaler at Harvard, who were the basis of the camp. Of that number the following have done professional work, and some of them still are doing it:

Wilbur F. Barclay, Russellville, Kentucky.
Malcolm H. Crump, Bowling Green, Kentucky.
Wm. M. Davis, Cambridge, Massachusetts.
J. W. Fewkes, Washington, D. C.
Jno. Alva Myers, W. Liberty, West Virginia.
Jno. Murdock, Cambridge, Massachusetts.
H. H. Straight, Oswego, N. Y., father of the late Major Straight.
J. E. Todd, Tabor, Iowa.
R. H. Wildberger, Clarksdale, Mississippi.
J. S. Diller, Washington, D. C.
Geo. H. Eldridge, Cape Cod, Massachusetts.
S. S. Green, Swarthmore, Pennsylvania.
W. M. Linney, Harrodsburg, Kentucky.
H. A. Mertz, Bethany, West Virginia.
Richard Parsons, Plymouth, Ohio.
W. L. Titus, So. Amesbury, Massachusetts.
F. Jackson, Boston, Massachusetts.

Among the visiting instructors were Dr. Safford, state geologist of Tennessee, Mr. Kerr, state geologist of North Carolina, and David Starr Jordan, the star fisherman of the occasion.

The students were provided each with a steel hammer weighing some four pounds, together with note books, suited to the work, compass, clinometer and a bottle of hydrochloric acid for distinguishing the difference between ordinary limestone and dolomite (the writer has his tools yet). Parties of four to six were sent out with some one of the faculty for one to several days, with instructions to make sections along the road from the Gap on one side as far as Morristown, Knoxville, Speedwell, also along the mountains on the Kentucky side for the outcrops of coal which abounded in that vicinity. Reports were made on the return which were criticized in public by Shaler under a large lecture tent that formed a conspicuous portion of the camp.

Lectures were given every night by Shaler or some member of the faculty, with illustrations on blackboards, etc. The students were housed in several large tents, provided with cots, water being very convenient from a large spring near by; meals were supplied and served in another tent of considerable size and were prepared by the most important individual of the camp, known as Jim, very black, from Frankfort, Kentucky, with an assistant, even blacker, if possible, who knew how to fry chicken and make the best corn-bread, which even the New Englanders learned to love. Colonel McKay occupied a large private tent, with his original shoemaker's bench and kit of tools, with which he frequently came to the rescue of the unfortunate whose footgear needed attention.

There was also a party of topographic engineers in charge of William Byrd Page, a distinguished graduate of the Virginia Military Institute, of Norfolk, Virginia, with his several assistants. He had been delegated from the state survey to head a party of the U. S. Coast and Geodetic Survey, who established a base line in Yellow Creek valley where Middleboro now stands; this was probably the first work of the kind done by the state and nation in Kentucky.

The camp broke about the second week in September into many small groups, each headed by some competent instructor, who went in various directions, the writer, with Wildberger, Barclay and Straight, accompanied by Dr. Safford, passed through East Tennessee to the North Carolina line, where we met Mr. Kerr, state geologist of North Carolina, and by him were introduced to the very difficult stratigraphy of the pre-Cambrian formations, up and along the French Broad, via the Hot Springs, where we met the widow and young daughter of Stonewall Jackson, thence to Asheville, where Mr. Kerr left us and we four pursued our way up the Swannanoah to Grey Eagle at the foot of Mt. Mitchell, thence the

next day to the top where we slept in the rain with a party of mountaineer cattle-herders, who kept a roaring fire during night. Here our mountain guide departed and left us to the mercy of the very indistinct blazes on the trees; we ran across Big Tom Wilson, who found the body of Dr. Mitchell, whose life was lost by falling over a precipice into a ten-foot pool of water; thence to the ancient mica mines of Bakersville, and Burnsville, where Wildberger was stricken with typhoid and with Straight was taken to a railroad some 75 miles away, while the writer and Barclay crossed Roan Mountain, stopped on the Tow River, spent our last quarter for supper, lodging and breakfast, and made the distance (40 miles) to Johnson City on one dime, which the lady who gave us dinner refused to take. We reached the railroad at Johnson City, where our finances were replenished, and home next day after a tramp of some 400 miles with much profit and still greater pleasure.

MALCOLM H. CRUMP
BOWLING GREEN, KENTUCKY

SCIENTIFIC EVENTS

ST. GEORGE EXPEDITION TO THE PACIFIC

THE St. George Expedition to the Pacific reached the Isthmus of Panama on June 9, 1924, and from there visited Isla del Rey in the Pearl Islands, Gorgona off the Colombian coast, some of the islands of the Galapagos group, Cocos (one day only, as weather conditions were unfavorable for a longer stay), Coiba Island and Taboga Island.

Zoological collections were made at all these islands. Mammals and reptiles were taken by Mr. P. H. Johnson, and his collection includes a white-faced black monkey, a three-toed sloth, three species of bat and a good series of rats from Gorgona; a howling monkey from Coiba Island and a series of rats exhibiting a wide range of variation from the Galapagos Islands.

Over three hundred specimens of birds have been obtained by Lieutenant-Colonel H. J. Kelsall. This is far less than he had hoped for, but various unforeseen and unavoidable difficulties in connection with collecting were experienced. Four species only of land birds were obtained on Gorgona during eight days' careful collecting; and, of these, two only were at all common. The forest, which is fairly dense, was penetrated to the summit of the highest peak, about 1,200 feet high, and up the courses of several of the very numerous streams.

Miss Cheesman has devoted her attention principally to those orders of insects which are most wanted by the British Museum as they are often not obtained by the ordinary collector. Lepidoptera and coleoptera have been collected by Mr. C. L. Collenette with the assistance of Miss C. Longfield. It is probable that some of the species of insects will prove to be new, but it is impossible to ascertain this until the collections have been worked out.

Dr. C. Crossland has collected the marine worms, Nudibranchs, Polyzoa, Hydroids and Algae. It is expected that these will afford most useful data for the settlement of synonomy and consequently for better knowledge of geographical distribution. At least five Atlantic species of polychaetes have been found in the Panama region, indicating that an appreciable number will be found common to both the Atlantic and the Pacific when the collections shall have been systematically examined.

Mr. J. Hornell has collected marine and terrestrial mollusca, while Mr. L. J. Chubb has amassed an extensive series of rock specimens and notes from the various islands.

The outstanding event of the expedition, so far as can be judged at present, has been the discovery of figures graven upon large boulders now lying between high and low water marks on the eastern shore of Gorgona. The first of these was found by L. Cullingford, one of the crew, and brought to the notice of Mr. J. Hornell, the ethnologist, who subsequently discovered a good many others. The most important were two series of archaic figures, among which are to be distinguished what appear to be rude representations of sun-gods and a stepped pyramid, together with figures of monkeys, birds and other animals. Besides these there are two comparatively modern sculptured portraits; one perhaps of Inca age, the other probably referable to the buccaneering days of the eighteenth century. Some stone weapons and implements were also found, associated with potsherds of considerable interest. Photographs and squeezes of the sculptures were taken and have been sent to the British Museum.

It was unfortunate that our botanist, Mr. L. A. M. Riley, was forced on account of serious ill-health to return to England from Panama; botanical specimens were, however, collected at most places by the other scientists and sent to Kew.

We understand from a cable recently received that much interest has been aroused by the archeological discoveries, while the authorities at Kew attribute considerable importance to the collection of flowering plants made at Gorgona, in consequence of which the scientific staff have decided to pay a second visit to this interesting island in order to search it thoroughly for further archeological remains, and to make the botanical material as complete as possible. It is intended to explore the western side and southern end of the island, which it was not found possible to do during our first visit.

An interesting series of kinema and still photo-

graphs of bird and other animal life was obtained at the Galapagos Islands.

JAMES HORNELL,
Ethnologist and scientific director,
CYRIL CROSSLAND,
Marine biologist,
G. H. JOHNSON,
General biologist,
H. J. KELSALL, LT.-COL.,
Ornithologist,
L. C. CHEESMAN,
Entomologist,
C. L. COLLENETTE,
Assistant entomologist,
L. J. CHUBB,
Geologist.

S. Y. "ST. GEORGE,"
BALBOA, SEPTEMBER 27, 1924

BIOLOGIA GENERALIS

It is the purpose of this note to call attention to a new biological journal, available to American workers, the first number of which will appear shortly. This journal, *Biologia Generalis*, is truly international in character, accepting contributions in either English, French, German, Italian or Russian, according to the author's wish. The responsible editorship rests in the following three persons: Professor Vladislav Ruzicka, Institute of General Biology, Prague, Czecho-Slovakia; Professor Leopold Löhner, Institute of Physiology, Graz, Austria; and the writer of this note. Cooperating with these three are the following coeditors:

J. Athanasiu, Bucharest; E. Bataillon, Montpellier; D. Calugareanu, Cluj; C. M. Child, Chicago; F. A. E. Crew, Edinburgh; Sp. Dontas, Athens; G. H. J. Ekman, Helsingfors; E. Giglio-Tos, Cagliari; E. Gley, Paris; E. Godlewski, Jr., Cracow; J. A. Bierens de Haan, Groningen; R. G. Harrison, New Haven, Conn.; L. J. Henderson, Cambridge, Mass.; E. Herouard, Paris; J. S. Huxley, Oxford; N. K. Kolzow, Moscow; S. Kopec, Pulawy; J. Krizenecky, Brno; W. W. Lepeschkin, Prague; A. Lipschütz, Dorpat; S. J. Metalnikoff, Paris; B. Nemec, Prague; Ch. Ogawa, Kyoto; O. Polimanti, Perugia; H. Poll, Berlin; M. Popoff, Sofia; O. Porsch, Vienna; H. Przibram, Vienna; J. A. M. Runström, Stockholm; J. Schaxel, Jena; Ch. R. Stockard, New York; S. Tschulok, Zurich; J. Wilczynski, Wilno; B. Zarnik, Zagreb; M. Zawadowski, Moscow. The late Sir William Bayliss was a coeditor up to the time of his lamented death.

The responsible publisher is Emil Haim and Company (Vienna and Bratislava, C. S. R.), and the American publisher's agent, The Johns Hopkins Press. The journal will appear in numbers of five signatures each, six numbers forming a volume. The numbers will, in general, appear at as frequent intervals as the accumulation of material for publication demands.

That there is room for a new first-class journal of general biology, offering opportunity for the prompt publication of original investigations in this field would seem to admit of no argument. There is an ever-increasing pressure of good work on the available avenues of publication. Such a journal will, in a sense, supplement the several well-established series of biological monographs which exist, among which may be mentioned the well-known "Vorträge und Aufsätze über Entwicklungsmechanik," edited by Roux; the equally well-known and established American series of "Monographs on experimental biology," founded by Loeb, Morgan and Osterhout; the "Bibliothèque de la biologie générale" of M. Caullery; and the "Abhandlungen zur theoretischen Biologie und Arbeiten auf dem Gebiete der experimentellen Biologie" of Schaxel. At the present time the current literature of general biology, because of its manifold and close points of contact with the various organic and inorganic sciences, is scattered in a great number of different journals. Out of these considerations arose the determination to establish a journal devoting the major portion of its space to the publication of original investigations in the field, and at the same time impartially reporting in short abstracts the results of work published elsewhere.

Biologia Generalis will be open to original articles dealing with the three main divisions of general biology, namely, general morphology, physiology and ecology, without prejudice to the different methods or direction of research except the purely metaphysical ones. The editorship hopes that all workers interested in general biology and kindred branches of science will make full use of this journal.

Manuscripts and inquiries relating to editorial matters originating in America should be sent to Raymond Pearl, Department of Biometry and Vital Statistics, The Johns Hopkins University, Baltimore, Maryland. American inquiries relating to subscription and other business matters should be addressed to The Johns Hopkins Press, Homewood, Baltimore, Maryland.

RAYMOND PEARL

THE SECOND AMERICAN ASSOCIATION PRIZE

AT the regular fall meeting of the executive comcommittee of the American Association for the Advancement of Science it was decided that the arrangements for awarding the second American Association prize are to be similar to the arrangements by which the first prize was awarded last year at Cincinnati.

As in the case of the first prize, the amount of the second prize is to be one thousand dollars, which is to be awarded to the author of a noteworthy contribution to science presented at the approaching fifth Washington meeting of the American Association and associated organizations. The prize is not competitive in the usual sense and no formal entry of papers will occur. Only papers that appear on the program of the Washington meeting will be considered. The programs of all the scientific societies meeting with the association at Washington will be considered, as well as those of the association itself. Since it is the aim of the association to further the advancement of American science and education in all feasible ways, it will not be necessary that the chosen contribution be by a member of the association.

The award will be made at the close of the meeting and it will probably be announced late on January 3, 1925, in time for the Sunday morning papers of January 4. It will be made by a committee of scientists to be named by the council early in the meetings. The committee on award will receive from the secretaries of the sections and societies meeting with the association at Washington suggestions of noteworthy contributions in the various fields of science.

The inauguration of the American Association prize, which occurred last year at the seventy-fifth anniversary, at Cincinnati, aroused interest to a marked degree. The recipient of the first prize was Professor L. E. Dickson, of the University of Chicago, for a great contribution to mathematical science. It is expected that the interest in the second prize to be manifested by those in attendance at Washington and by the intellectual public as well, will even surpass the interest shown last year. The American Association is particularly gratified to be able to continue awarding these thousand-dollar prizes. Through the great generosity and helpful spirit of one of the members of the association, arrangements have been made by which five annual prizes are now provided for, in addition to the prize awarded last year. It is planned that the prize will be awarded at each of the four annual meetings following the fifth Washington meeting. The third prize will be awarded at the Kansas City meeting, at the close of the year 1925; the fourth prize at the fifth Philadelphia meeting, at the close of 1926; the fifth prize at the meeting to occur at the close of 1927 (place of meeting as yet undecided); and the sixth prize at the fifth New York meeting, at the close of 1928.

BURTON E. LIVINGSTON,
Permanent Secrttary

DINNER OF THE NEW YORK ALUMNI OF SIGMA XI

A DINNER for the alumni of Sigma Xi, of which there are about one thousand members in New York City, has been arranged to take place on Monday evening, November 17, at 7:00 P. M., at the Fraternity Club, 245 Madison Ave., New York City.

The "New battle front of civilization" will be the topic of the principal address by Dr. Vernon Kellogg, secretary of the National Research Council and a member of the executive committee of Sigma Xi. Supplementary remarks on the same topic will be made by Dr. E. L. Thorndike, professor of psychology at Columbia; Dr. Edwin E. Slosson, director of Science Service; F. B. Jewett, vice-president in charge of research of the Western Electric Company; Dr. Francis Carter Wood, director of cancer research, Crocker Laboratory, and Dr. Michael Pupin, professor of electromechanics at Columbia University. President F. K. Richtmyer, of Cornell University, will be present to explain the broad program upon which Sigma Xi is embarking. Secretary Edward Ellery, of Union College, will act as toastmaster. Invitation cards may be obtained from C. E. Davies, chairman.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE WILLIS RITCHEY, of the Solar Observatory, California, has been awarded the Janssen gold medal by the Paris Academy of Sciences for his work in connection with the construction of the reflecting telescope.

DR. JOHN M. T. FINNEY, professor of clinical surgery at The Johns Hopkins University, has been elected foreign corresponding member of the Royal Academy of Medicine of Belgium.

THE French Government has conferred the decoration of chevalier de la Légion d'Honneur upon Dr. W. H. Hobbs, professor of geology; Dr. F. G. Novy, professor of bacteriology, and Dr. H. P. Thieme, professor of Romance languages, all of the University of Michigan.

A NEW portrait of President E. A. Birge, of the University of Wisconsin, by Merton Grenhagen, of Milwaukee, has been completed and will soon be hung in the Regents room of the university. A portrait of of Professor R. L. Jones, of the College of Agriculture, has also just been completed by Mr. Grenhagen to be hung in agricultural hall.

THE University of Pennsylvania has announced that a further gift had been made by John C. Bell for the erection of statues in honor of two former provosts of the university, Dr. Charles C. Harrison and Dr. Edgar Fahs Smith. It is expected that the two statues will be completed in time for presentation to the university next commencement day. Dr. R. Tait McKenzie, director of physical education, is to be the

sculptor for the statue of Dr. Smith, while Lynn Jenkins, the English sculptor, is creating that of Dr. Harrison.

Dr. P. B. Berloty, director of the Ksara Observatory in Syria, has been elected a corresponding member of the French Academy of Sciences in the section of geography and navigation, in the place of P. Colin.

The Budapest Veterinary Academy has conferred the degree of doctor of veterinary sciences, *honoris causa,* on Sir John McFadyean, principal of the Royal Veterinary College, England.

The Beal medal of the American Gas Association, awarded annually for the best technical paper presented at previous meetings of the association, has been awarded to A. W. Warner, of Chester, Pa., for his paper entitled "The study of physical laws governing carbonization of coal."

Dr. George C. Whipple, Gordon McKay professor of sanitary engineering at Harvard University, has been commissioned in the Reserve of the United States Public Health Service as directing sanitary engineer with the grade of assistant surgeon general.

At the Storrs Agricultural Experiment Station Dr. Walter Landauer, formerly of the Zoological Institute, Heidelberg University, has joined the staff as fellow in genetics (poultry investigations). Miss Margaret Schneider has been granted leave of absence for the first semester and is studying in the department of zoology, Columbia University.

W. Taylor Thom, Jr., has been appointed geologist in charge of the newly formed section of geology of fuels in the Division of Geology, United States Geological Survey.

Alden H. Moody, recently with the Union Carbide and Carbon Research Laboratories, has joined the chemical staff of the Brooklyn Polytechnic Institute.

J. J. Marris, nitrogen chemist of the Mississippi Department of Agriculture, has been appointed to the staff of Law & Co., consulting and analytical chemists at their Wilmington, N. C., laboratories.

Neil Hotchkiss, a graduate of Syracuse University, has been appointed assistant in agrostology (junior botanist) in the United States Bureau of Plant Industry.

Professor S. Lefschetz, of the University of Kansas, has been appointed visiting professor of mathematics at Princeton University for the year 1924–25.

Dr. Henry McE. Knower is spending this winter as visiting professor of anatomy, in charge of the courses in histology and neurology at the medical college of the University of Georgia, Augusta.

Dr. C. B. Hutchinson, director of the branch of the College of Agriculture of the University of California at Davis, has left for Europe to join Dean A. R. Mann, of the College of Agriculture at Cornell University, at the International Institute of Agriculture in Rome. They will study conditions of agriculture and engage in the promotion of agricultural research and instruction and do not expect to return for two years.

Professor George G. MacCurdy, of the Peabody Museum, Yale University, recently returned from France, bringing over relics of men and animals of the pre-historic age. Since last spring he has been excavating at Sergeac, near Bordeaux, and at Solutre, near Lyons.

Dr. Haven Emerson, professor of public health administration in the Columbia University College of Physicians and Surgeons, New York, will make a survey of health conditions in Cincinnati beginning about November 10.

Mr. and Mrs. Visser, whose first expedition to the Karakorum Mountains, a spur of the Himalayas, in 1922 met with insurmountable obstacles, intend to start a second expedition in 1925.

Mrs. Agnes Chase, assistant agrostologist of the United States Bureau of Plant Industry, sailed for Brazil on October 18, where she will remain about six months studying and collecting grasses.

Dr. Herbert E. Ives lectured before the Western Society of Engineers, in Chicago, on October 20, on "The transmission of photographs over telephone lines," describing the system recently developed by engineers of the Bell system.

Dr. C. B. Bazzoni, professor of experimental physics in the University of Pennsylvania, delivered a lecture on "The atomic nucleus" before the Swarthmore chapter of Sigma Xi on October 28.

Dr. Thorwald Madsen, director of the Serological Institute, Copenhagen, Denmark, delivered the Wesley M. Carpenter lecture, of the New York Academy of Medicine, on October 16.

Dr. Otto Oldenberg, of the University of Göttingen, Germany, gave a lecture on October 29 at the Massachusetts Institute of Technology entitled "Phosphorescence and fluorescence phenomena."

Professor E. C. C. Baly, of the University of Liverpool, addressed the New York section of the American Chemical Society on November 3 on the subject "Photosynthesis."

DR. H. J. PAGE, of Harpenden, England, gave a lecture at Cornell University, October 1, on "The work of the Rothamsted Experimental Station."

DR. CHARLES EDWIN PERKINS, clinical professor of otology in Bellevue Hospital Medical College, died on October 23, at the age of fifty-seven years.

DR. JOHN VAN DENBURGH, physician and head of the department of herpetology of the California Academy of Sciences, has died by suicide.

EDWARD LOTHROP RAND, corresponding secretary of the New England Botanical Club from 1895 until 1921, died at his home in Cambridge, Mass., October 9, 1924. A correspondent writes: Mr. Rand was born in Dedham, Mass., on August 22, 1859. He was graduated from Harvard College in 1881 and from the Harvard Law School in 1884. He practiced law in Boston for many years, but devoted much attention to botany. In collaboration with the late John H. Redfield, of the Philadelphia Academy of Natural Sciences, he prepared and in 1894 published a detailed Flora of Mount Desert Island, Maine, which at the time was one of the most complete works of its nature that had appeared in any part of America. He was among the founders of the New England Botanical Club and was a member of the publication committee of its journal, *Rhodora,* from 1898 until his death. He gave to the club in 1914 his extensive herbarium of Mount Desert plants.

THE president-elect of Mexico, General Calles, and a group of Mexican physicians and public men visited the Pasteur Institute, Paris, on Wednesday, October 8, 1924. They were received by Dr. Roux, the director, and members of the staff of the institute. In a few words of welcome Dr. Roux expressed his pleasure at the interest of the president in medical research and measures to promote public health. General Calles was invited to sign the Golden Book of the institute and, as a souvenir of the occasion, was presented with a portrait of Pasteur. The party was then shown the apartments of Pasteur and the permanent exhibit of his apparatus and mementos, and afterwards the various laboratories of the institute and the magnificent tomb of Pasteur.

THE joint program of Section G, of the American Association for the Advancement of Science with the Botanical Society of America, the American Phytopathological Society and other botanical organizations, will be held on Tuesday afternoon, December 30. This program, which occupies the afternoon of the first full day of the Washington meeting, will be opened by an address on "The origin of the cycads," by the retiring vice-president of Section G, Dr. C. J. Chamberlain. This address will be illustrated. The following invitation papers will then be presented: "Root studies," by Dr. J. E. Weaver, of the University of Nebraska. "Soil nutrients," by Dr. E. J. Kraus, of the University of Wisconsin. "Mosaic and related diseases," by Dr. L. O. Kunkel, of the Thompson Institute for Plant Research. Correspondence should be addressed to the secretary, Dr. Robert B. Wylie.

THE American Society of Naturalists will meet in Washington, D. C., on Thursday, January 1, 1925. Headquarters of the society will be the Hotel Raleigh, Pennsylvania Avenue and 12th Street, N. W. The rates are $3.00 to $10.00. The morning program will be devoted to an address by Dr. John C. Merriam. In the afternoon a symposium on growth will be participated in by Drs. Alexis Carrel, Charles R. Stockard, Lafayette B. Mendel and D. T. MacDougal. The evening will be occupied with the annual dinner and the address of the president, Professor W. H. Howell. No preliminary notice of the meeting will be mailed to members this year.

THE fifteenth annual meeting of the American Association for the Advancement of Agricultural Teaching will be held at the Willard Hotel in Washington on November 11.

THE annual meeting of the American Society of Agronomy will be held in Washington, D. C., on November 10 and 11, under the presidency of M. F. Miller. There will be symposia on the following subjects: Economic relationships of agronomy, agronomic observations in foreign lands, soil colloids, nitrogen fixation, the legume problem and plant physiology and agronomic science.

AT the Madrid meeting of the International Geodetic and Geophysical Union, held from October 1 to 10, it was decided to hold the next congress in Prague in 1927.

AT the regular meeting of the New Jersey Chemical Society held in Newark on October 14, David Wesson, consulting chemist, Southern Cotton Oil Co., delivered his presidential address on "Some chemical problems and responsibilities." Dr. Jerome Alexander, consulting chemist, New York City, gave an address entitled "Bridging the gap between masses and molecules."

AT a symposium at the Pittsburgh, Pa., station of the U. S. Bureau of Mines, dealing with the subject of the importance of chemistry in food product development, October 16, the following speakers gave addresses: John C. Fetterman, director, National Certification Laboratory, "The chemist in the dairy industry"; H. N. Riles, director of research, H. J. Heinz Co., "The chemist in the packed food industry"; T. B. Downey, senior industrial fellow, Mellon Institute, "The chemist in the edible gelatin industry,"

and E. S. Stateler, technologist, Hershey Brothers, "The chemist in the confectionery industry."

The will of the late Elizabeth Blee Frasch directs that her estate of over $5,000,000 be held in trust by the United States Trust Company and the income be used for "research in the field of agricultural chemistry, with the hope of attaining results which shall be of practical benefit to the agricultural development of the United States." It is provided that the trustee after advising with the American Chemical Company select one or more incorporated institutions in the United States and pay the income to them upon the condition that they agree that the money will be devoted to research in agricultural chemistry.

The will of the late Henry R. Towne, engineer and head of the Yale and Towne Manufacturing Company, disposes of an estate estimated at several millions and gives the bulk of it as a residuary bequest after the death of his son, to establish museums of peaceful arts, or industrial museums for the people of the City of New York. He gave $50,000 for "a campaign of education, news and publicity designed to bring prominently to public notice essential facts concerning the great industrial museums of Europe." If it is deemed inexpedient by the executors and trustees, by unanimous judgment, to expend funds for peace museums, the residuary estate is to be divided into two equal parts for the benefit of the Metropolitan Museum of Art and the American Museum of Natural History. Other bequests include $10,000 for the Franklin Institute of Philadelphia to be held in trust as a fund in memory of Mr. Towne's father, the late John Henry Towne, who was actively connected with the institute; $50,000 fund, to be known as the "Henry R. Towne Engineering Fund," to the United Engineering Society of New York, and $10,000 to New York University for its endowment fund.

The residue of the estate of the late Mrs. Gordon Dexter, of Boston, estimated at several hundred thousand dollars, is left to Harvard University for research in bacteriology and for the purchase of books for the library.

New York may acquire a community forest, or plant one, by recommendation of Professor Hugh Findlay, of Columbia University, who is directing work along the lines of reforestation and tree conservation for university extension students. Central Park and the New York Botanical Gardens will be used by his students as laboratories in experimental work. A special investigation will be made of the importance of birds to forest and home trees, and of the use of trees in industry.

UNIVERSITY AND EDUCATIONAL NOTES

The University of Chicago has set aside a tract of nine acres, the two blocks west of Ellis Avenue facing the midway, to be devoted wholly to the new medical school. The buildings now on this tract will be removed in time, and the university will immediately spend $4,000,000 for hospitals, laboratories and teaching quarters, and eventually not less than $3,000,000 more. To endow the work to be housed in these buildings will call for $5,000,000 in the near future.

The Worcester Polytechnic Institute is planning a new mechanical engineering building to cost approximately $350,000.

Yale University and the New York Nursery and Child's Hospital are named residuary legatees in the will of the late Mrs. Lucie A. Bliss. The fund for Yale is to be used for increases in salaries of professors.

Professor John Barlow, for 21 years head of the department of zoology in Rhode Island State College, has been appointed dean of the general science course in that college.

Following the recent resignation of Dr. Henry Page, a committee has been appointed by the board of directors of the University of Cincinnati to administer the work of the college of medicine. The members are: Dr. Arthur C. Bachmeyer, superintendent, Cincinnati General Hospital; Dr. Alfred Friedlander and Dr. Nathan C. Foot. Dr. Bachmeyer, as chairman of the committee, will be the acting dean.

Dr. Edwin G. Boring, associate professor of psychology at Harvard University, has been appointed director of the psychological laboratory.

At Harvard University, Dr. Robert B. Osgood has been appointed John B. and Buckminster Brown professor of orthopedic surgery to succeed the late Professor Robert W. Lovett and Dr. William L. Moss has been appointed assistant professor of bacteriology.

E. M. Spieker has been granted leave of absence from the United States Geological Survey to give a course of instruction in geology at Ohio State University.

H. W. Wright has accepted a position as professor and head of the department of chemistry in Union College, Kentucky.

Dr. E. Fiterre, who has been studying in Paris on the Albarran fellowship for two years, has been appointed associate professor of physiology at the University of Havana.

Dr. Carl F. Schmidt has been appointed assistant professor of pharmacology at the University of Pennsylvania.

HAROLD A. LARRABEE, who has just returned from a year of study in Europe on a fellowship from Harvard University, has been appointed assistant professor of psychology in the University of Vermont.

PAUL E. EATON, of Ithaca, N. Y., has been appointed assistant professor of mechanical engineering at Lafayette College.

APPOINTMENTS to the staff of the University of Pennsylvania School of Medicine have been made as follows: Dr. George Fetterolf, professor of otolaryngology, succeeding Dr. Burton Alexander Randall, retired; Dr. J. Claxton Gittings, professor of pediatrics, succeeding Dr. J. P. Crozer Griffiths, also retired, and Dr. William C. Stadie, assistant professor of research medicine.

DISCUSSION AND CORRESPONDENCE

THE TEMPERATURE OF MARS

IN a note published in the issue of SCIENCE of October 24, *Science Service* anonunces the results of the measurements on Mars, taken at Mt. Wilson. These measurements indicate that the noonday temperature on the Martian equator is about 10° C. or 42° F. Then, referring to the results obtained at the Lowell Observatory, Flagstaff, Arizona, previously announced in SCIENCE of September 26, in which the temperature of Mars under a noonday sun was found found to be *up to* 20° C. (*sic*) the comment is made that these two "observations are not in complete agreement."

In view of the fact that this statement has already caused doubts in the minds of some of those uninitiated in the intricacies of the problem a few supplementary remarks are in order.

When we consider 10° C. with 20° C. then it is true that there is a difference of 10° C.—and this on a planet 34 millions of miles away. But it is of interest to note that, if two laboratories undertook to measure the radiation from some close-by terrestrial source, at 15° C., the chances are that their temperature estimates would differ by 10°—and they would not be harrassed by the incompletely solved question of the spectral transmission of a dense atmosphere like that of the Earth, not to mention the everchanging clouds on Mars. But 10° C. difference has no significance in comparison with what has been accomplished as a whole. For instead of disagreement it means agreement. It means that for the first time in history two observatories, working independently, have arrived at the conclusion, radiometrically, that the noonday temperature of the surface of Mars is considerably above 0° C., which is the view held by astronomers who, for years, have been making the observations visually.

No wonder I am receiving protests from some who, relying upon calculations which indicate maximum temperatures far below 0° C., say "You are wrong." Quite naturally, it is comforting to me to see the Flagstaff work of 1922 (from which temperature estimates of 10° to 20° C. were obtained) and of the present opposition of Mars, confirmed by the powerful instruments at Mt. Wilson.

On the other hand, the calculators of planetary temperatures can take comfort in the remark, made by the late Professor Edward Morley, that the mathematical mill is no different from any other—you grind out what you put in, nothing more. When we have sufficient and accurate data, upon which to base our assumptions, the calculated planetary temperatures will no doubt be in agreement with the observations.

W. W. COBLENTZ

TRENDS OF MODERN GEOGRAPHY

IN "Trends of modern geography" (SCIENCE, October 24, 1924, pp. 374–376), Dr. Clarence F. Jones has presented the viewpoint of a number of human ecologists, here and abroad, who would narrow the field of geography by relegating physical geography to another sphere. Nevertheless, every geographer, as part of his geographical training, must study the sciences of the land, the water and the air as the fundamental bases of modern geography; for no indifferently understood foundation can uphold the vast superstructure of human relationships to natural environment. No student at Clark, for example, is given a graduate degree in geography unless he can show a reasonable understanding of at least the following phases of geography: physiography, meteorology and climatology, soils, native vegetation, agricultural geography and land utilization, economic geography and anthropogeography. Should not then human ecology be recognized as but the crowning phase, rather than pressed on us as constituting the whole of geography? Can there be geography without the "geo-"?

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NOTE REGARDING THE TREATMENT OF EAR CANKER IN RABBITS

AS stated by David Marine, of Montefiore Hospital, New York, in SCIENCE of August 15, 1924, Vol. LX, p. 158, ear canker (*Psorocoptes cuniculi*) is one of the most troublesome diseases that has to be contended with in the rearing and care of rabbits. We have to be constantly on the alert to discover and treat it in the animal room of the Stanford Medical School. Our method, while different from the one recommended by Mr. Marine, is just as effective as the kerosene

spray which he recommends in the article referred to above. For many years we have used a 3 per cent. carbolized sweet oil. This should be sprayed or poured into the ear in sufficient amount to penetrate the paper-like structure which the mites construct. Any oil or member of the petroleum derivatives is instantly fatal to all insects and mites. Kerosene has the advantage of being more rapidly diffusible and penetrating than sweet oil; it is also more or less irritating and no doubt produces a smarting when applied to the sensitive inner surface of the ear. On the other hand, sweet oil acts less rapidly as regards penetration, but it is soothing and softens the scales, hastens desquamation of the dried epithelium and favors rapid healing; the phenol relieves the itching and antagonizes infection. The purpose of this note is not to criticize but simply to mention an additional therapeutic remedy for the disease.

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A METHOD FOR FACILITATING SCIENTIFIC READING

Much time is needlessly consumed by scientific workers in trying to locate in a journal or book some data they vaguely recall having read. I am not unusually impetuous, but it must be confessed that this particular loss of time has been extremely aggravating on occasions. For a period I projected, as psychologists now call it, my memory failings into the construction of the journals. I have said many bad things about editors for not furnishing a complete functional index with each volume, an index that would tell the research worker on just what pages lactic acid is mentioned or just where in the six hundred odd pages there are charts showing the development of fatigue effects in muscular work.

Perhaps I have wanted too much, but one must be consistent and maintain that there is at least some justification for his outbursts of criticism. At any rate the alphabetical list of authors or titles furnished annually by the journals does not provide fullest aid in locating missing tables and figures.

Criticism does not go very far. So it became necessary to make up for the editors' continued neglect. After trying several schemes I have decided that the one I shall describe leaves least to be desired. This is the adoption of visual tabs such as are used in office filing systems.

Whenever I chance across a reference to, or data on ventilation I now paste a strip of light lavendar paper about 5 mm by 20 mm on the upper edge of the page—provided, of course, it is my book or journal. In case it is a table of data that is being marked I write a "T" on the visible portion of the colored tab, which is about 5 mm square. If the tab happens to be indicating a chart the letter "C" is marked on the visible part, or "R" in case it marks a reference I am certain is not in my library or I do not have abstracted.

The complexity of such a functional index is limited only by the ingenuity and color discrimination of the user. At present I am using 26 colors without confusion, and with much saving of time and patience. Whenever I want research material for a class lecture or an article, for instance, on individual differences all I have to do is to thumb through the tops of my library and browse through the pages indicated by the blue tabs. If it is sex differences I am most interested in for the moment I open only the pages marked by the blue tabs with "sex" printed (by hand) on them; if it is racial differences only the blue tabs sub-divided by "race" are used as a guide in the reading. In an evening a hundred tables of data or charts or sagacious remarks can be located with a rapidity that brings great comfort and confidence.

Reprints can profitably be indexed in a similar fashion when they are read. Filing of these leaflets is usually accomplished in many modes which vary with the seasons. When a visual tab system is used to guide reference reading reprints may be filed in the easiest way to preserve their shape. The most economical way to do this is to punch two holes near the stapling and fasten two dozen or so together with large brass staples into a compact booklet. Related subjects can be stapled together, and those reprints that it is difficult to tell just where they belong in any rational classification—they are many—can be placed wherever the shelves need filling since the visual tabs will make the contents readily available on a moment's examination.

Colored tabs can be made from kindergarten paper which is easily obtained; the heavier the stock the better. These can be cut into strips 5 mm wide. Then these long strips can be cut *part way* across every two centimeters of their length, leaving about 1 mm of the stock holding the tabs in each strip together.

The best way to keep order in a hundred or more such strips has seemed to be to paste them on a piece of cardboard about 6 cm wide and as long as the number of colors (not strips) being used and anticipated indicate. The strips should be "tacked" on with a *small* area of paste along the long edge of the cardboard, so that the long axis of the colored strip is at right angles to the long axis of the cardboard. Several strips of the same color may be placed one

above the other, and as soon as the supply of tabs in any color is used up another set of strips may be prepared and pasted on this card.

The strips may be arranged according to the spectrum or by the alphabetical order of topics they are to indicate. I have found the latter more convenient, especially with the subject each color indicates written opposite the strips of that color on the cardboard holder. I have two such holders in use in daily reading, one at the laboratory and one at home. The preparation of additional strips furnishes constructive amusement to children who find kindergarten entertainments to their liking.

I have still to be convinced that a functional index, with almost the completeness of a dictionary, should not be demanded by the readers of scientific journals. In the meantime it is up to the readers to convince the editors of a serious omission in their commonly gratuitous undertaking.

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A PROPOSED BIOGRAPHICAL ENTOMOLOGICAL DICTIONARY

AMERICAN entomologists and arachnologists should be much interested in the project of Professor Embrik Strand to publish a Biographical Entomological Dictionary containing the autobiographies of all entomologists and arachnologists who have done scientific work as authors or as collectors in all parts of the world.

This project has been explained in *Entomological News*, May, 1924, page 178, also May, 1924, pages 227–9, and in *The Entomologist* for March, 1924, page 68. However, the response from American entomologists has not been very great. The project has several auspicious features that should warrant wholehearted and prompt support: (1) There is no question about the publication of data; (2) the editor appreciates the desirability of individuality in the form of the biographies; (3) it is not necessary to be saving of space, since the editor suggests that all the main points in the life of the individual, even though they may have nothing to do with the professional career, should be included; for example, work in other biological fields than entomology or arachnology.

All persons who have done work with insects or spiders are urged to send an autobiography to Professor Strand at the earliest opportunity. Professor Strand's address is: Professor Embrik Strand, Director of the Systematic Zoological Institute, Universität, Kronvalda bulvars 9, Riga, Latvia.

To facilitate the assembling of the autobiographies of Americans, it is suggested that they may be sent to Dr. H. P. K. Agersborg, Department of Biology, The James Millikin University, Decatur, Illinois, or to Professor C. L. Metcalf, 201 Natural History Building, Urbana, Illinois, who will be glad to forward them by registered mail to Professor Strand.

H. P. K. AGERSBORG
C. L. METCALF

SPECIAL ARTICLES

CAN THE HYDROGEN ION CONCENTRATION OF LIVING PROTOPLASM BE DETERMINED?

THE various determinations that have been made of H-ion concentration in organisms are applicable in the case of plants only to the cell sap, and in the case of animals usually to no more than body fluids bathing the exterior of the cells. To assume that the results correspond to the cH of the protoplasm in contact with these inanimate fluids would be unjustifiable, as the following experiments will demonstrate. The subject of study is *Pelomyxa palustris*, a multinucleate Amoeba which frequently attains the giant size of 3 mm or more in diameter. Its markedly vesicular or foam structure renders this organism peculiarly suitable for colorimetric tests of cH; for, since it is desirable that the indicator should be as uniformly distributed as possible, and since it is impossible, as far as I am aware, to impart a visible coloration to living protoplasm itself, the nearest approach to ideal conditions is afforded by such an intimate foamy admixture of protoplasm and vacuolar fluid as *Pelomyxa* presents. The average diameter of the vacuolar vesicles is one third to one half that of the nuclei, but larger and smaller ones also occur. Neutral red was the indicator used. It is absorbed readily from dilute solution and forms in the vesicles a much more concentrated solution than in the external liquid. Granules in the protoplasm also stain deeply, but their color is little affected by the cH of any medium in which they may be placed and so is of no use as an indicator.

The tint of the neutral red in the great majority of the vesicles is practically uniform and corresponds sometimes to a neutral and sometimes to a very slightly acid medium. It is more acid than the water outside—a relation which seems to hold whenever the cH of cell vacuoles is compared with that of the bathing fluid. Comparing therefore the three media, cell sap, protoplasm and external liquid, we see that the neutral red has a different concentration in all three media and the H-ions in at least two of them. Why, then, should we assume that their concentration in the protoplasm agrees with that of the internal rather than the external liquid or indeed with either?

There is, however, more convincing evidence that the protoplasm is deliminated sharply as regards

acidity from at least some of its vacuoles, for certain of these may assume a cH widely differing from that of the rest. Parenthetically it may be remarked that *Pelomyxa* is a gross feeder and is usually crammed with algae, diatoms, small animals, sand and débris. These lie in the vacuoles and the living ingesta are for the most part apparently uninjured by their situation, proving the innocuous character of the contents of the ordinary vacuoles. An occasional vesicle, however, may assume digestive functions. Usually a few of these are to be seen in any large *Pelomyxa*. I have watched the acidity increase in an ordinary vacuole until the neutral red assumed a deep purple or bluish tint. The contained alga, green and apparently healthy to begin with, having its own vacuole stained orange by the dye, lost the orange hue of its sap, lost its green color and became ultimately disorganized. At a later stage one finds in such vacuoles only a collection of strongly stained granules in rapid Brownian movement. The granules diminish in number, apparently passing into the protoplasm, and the hue of the indicator returns to normal. Very occasionally an alkaline vesicle may be observed—deep yellow with neutral red—containing a few granules (still of the same deep red color as in an acid vacuole). Since the ordinary vacuoles do not contain granules this may represent a subsequent stage in the history of a digestive vacuole.

These phenomena illustrate very well how, even in a liquid circulating mass of protoplasm, chemical substances and chemical operations may be localized within narrow limits. More particularly they demonstrate that the H-ion concentration of a vacuole can be no criterion of that of the protoplasm that surrounds it—may indeed be such as applied externally would be lethal.

Similarly, the absence of any distinct local variations in cH in the vesicles of *Pelomyxa* during the cycle of physical changes that attends its amoeboid movement does not prove that no such variations of cH take place in the protoplasm.

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THE TOTAL IONIZATION PRODUCED IN AIR BY ELECTRONS OF VARIOUS ENERGIES

Recent experiments on the total ionization produced by slow electrons in air have yielded results in agreement with the Bohr[1] theory of ionization in the region of the faster, low-speed electrons for which exact ionization experiments had not previously been performed. Since the experiments with very slow electrons have indicated an increase in the ionizing efficiency of electrons with increasing speed and experiments with hard cathode-rays and β-rays have shown the same quantity to decrease with increasing velocities it appeared that a maximum value must lie somewhere in the intervening range.

Previous experiments with low-speed particles have been limited in their application due to the fact that at the pressures used the electrons with the greater energies in this range hit the sides of the ionization chamber before their energy had been exhausted. In these experiments an ionization chamber of hemispherical shape was sealed off from the tube where the electrons were emitted from a hot tungsten filament, except for a small capillary hole in the anode, one end of which was 2 mm from the filament and the other end at the geometric center of the ionization chamber. By running a diffusion pump system during the experiment, and adjusting an artificial leak into the ionization chamber the air pressure in the filament tube was kept between 0.0001–0.001 mm, while the pressure in the chamber was varied at will from 0.001 to 1.5 mm. The latter pressure was adjusted until the radius of the vessel was just greater than the range of the electrons used, and the number of electrons which passed into the chamber and the number of positive ions produced by them were measured with a quadrant electrometer. This was done at frequent voltage intervals as the accelerating voltage between the filament and the anode was raised to 1,500 volts, and a graph was made of the number of ions produced per electron plotted against the energy of the electrons expressed in volts.

Bohr's theory considers both primary and secondary ionizations and predicts that, for a gas with a single ionization potential, ionization will set in when the energy of the colliding electron expressed in volts is equal to this potential. The average ionization produced per unit path will rise rapidly to a maximum at twice the ionization potential and then decrease slowly; for gases with several ionization potentials the position of the maximum is shifted to higher voltages. R. H. Fowler[2] has shown that a numerical factor of approximately three fourths should be introduced in the Bohr equation when the distribution of the velocities of emission of the secondary electrons is taken into account. The theory also predicts sudden breaks in the ionization curves when the accelerating voltage becomes equal to large ionization potentials compared to which the other potentials are small. This should occur in air at potentials belonging to electrons on inner rings of argon, nitrogen and oxygen. Assuming that all the energy of the electron

[1] Bohr, N., *Phil. Mag.*, *25*, 101 (1923); *30*, 581 (1915).

[2] Fowler, R. H., *Proc. Camb. Phil. Soc.*, 21, 521, 531 (1923).

will be used in ionizing collisions Bohr has derived an expression for the range of the electrons, which for small velocities gives a fourth-power relationship between the velocity of the electron and its range, with a deviation from this law when the ratio of its velocity to the velocity of light is not negligible.

An examination of the experimental curve obtained has shown that ionization of air by electrons sets in at about 17 volts, the ionization potential of the nitrogen molecule, and rises rapidly to a maximum between 125–130 volts, a value in agreement with Mayer's[3] determination of this maximum which is due to primary ionizations. The curve rises again when secondary ionization starts near 170 volts, and sudden breaks in the curve occur at approximately 250 volts, 375 volts and 500 volts, the ionization potentials of the L-electrons of argon and the K-electrons of nitrogen and oxygen. These potentials are in agreement with the values obtained in the X-ray and photoelectric experiments of Kurth,[4] and Mohler and Foote[5] with nitrogen and oxygen, and in the recent ionization experiment of ughes and Klein[6] with argon. In this region the efficiency of ionization is never more than 20 per cent., as also has been observed by Hughes and Klein.[6] Above 550 volts ionization increases rapidly until near 1,000 volts the rate of increase becomes steady. Determinations of total ionization have been made up to 1,500 volts.

For a number of voltages the critical pressure for which the radius of the chamber was equal to the corresponding range of the electron was measured, and a graph shows that a good linear relation exists between the energy of the electron expressed in volts and the square root of the corresponding critical pressure. The slope of the line leads to the following form of the voltage-range law for low-speed electrons, where V is given in volts, and R is measured in cm at 760 mm pressure:

$$V = 16300 \sqrt{R}$$

In other words, this is another verification of the fourth-power relationship between the velocity and range of an electron, first experimentally verified by Whiddington.[7]

In his recent cloud experiments C. T. R. Wilson[8] has measured the length of ionization tracks which are probably due to electrons of 7,700 and 8,600 volt energies, from which he has deduced a value of 21,000 for the coefficient in the voltage-range equation. For such voltages the variation of the mass of the electron with its velocity is not negligible and becomes large in the range of velocities used in the absorption experiments of Schonland[9] with cathode rays, and Varder[10] with β-rays. Their results lead to a determination of the coefficient which varies from 22,000 to 7,000 as the velocity of the particle increases. As Fowler has pointed out the value of the coefficient as predicted by the Bohr theory for low velocities, about 7,000, should be multiplied by a numerical factor of 2 or 3.

By use of the above experimentally determined law and the average value of the total ionization produced by electrons at the various energies used in the experiment, the average ionization per cm of path at 1 mm pressure was calculated and the resulting graph gave a sharp maximum near 990 volts with an expenditure of about 24.1 volts of energy per ion pair, which is approximately the value predicted by Fowler and slightly less than that determined by Wilson at higher voltages. It appears that for high voltages primary ionization of air consists of the emission of the K-electrons of the oxygen atom and that secondary ionization is due to the emission of the L-electrons from nitrogen.

It is possible to compare the values for the ionization produced by the highest speed electrons used in the experiment with the results obtained by Glasson[11] with hard cathode rays. For voltages beyond 1,000 the total ionization increases at a steady rate, so that by extrapolation and by use of the voltage-range equation a value of 1.43 ions per cm has been calculated for 4,000-volt electrons, as compared with the value, 1.5, determined by Glasson at this voltage.

It has seemed advisable to make a short preliminary report of the results of this experiment which verify the Bohr theory of ionization as corrected by Fowler, since the publication of the detailed description of the experiment may be delayed by an attempt to extend the range of voltages used in the experiment.

In conclusion, the author wishes to acknowledge her indebtedness to Professor A. F. Kovarik, who suggested the experiment and gave her much valuable advice.

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[3] Mayer, F., *Ann. d. Phys.*, *45*, 1 (1914).

[4] Kurth, E. H., *Phys. Rev.*, *18*, 461 (1921).

[5] Mohler, F. L., and Foote, P. D., Scien. Papers Bur. of Stand., No. 425 (1922).

[6] Hughes, A. Ll., and Klein, E., *Phys. Rev.*, *23*, 450 (1924).

[7] Whiddington, R., *Proc. Camb. Phil. Soc.*, *16*, 321 (1911).

[8] Wilson, C. T. R., *Proc. Roy. Soc.*, A, *104*, 1, 192 (1923).

[9] Schonland, B. F. J., *Proc. Roy. Soc.*, A, *104*, 235 (1923).

[10] Varder, R. W., *Phil. Mag.*, *29*, 725 (1915).

[11] Glasson, T. L., *Phil. Mag.*, *22*, 647 (1911).

THE REACTIVITY OF LIQUID PHOSGENE[1]

Modern inorganic chemistry has developed around the so-called "universal solvent," water, and most of our chemical ideas have been formed with reference to the more common aquo-acids, bases and salts, and their behavior towards water. That this particular chemistry is, however, only a special case of a broader universal chemistry has been shown by E. C. Franklin in his brilliant conception and demonstration of the existence of an entire series of ammono-acids, bases and salts, many of which are entirely incapable of existing in the presence of water, but whose behavior towards liquid ammonia, solubility, conductivity of their solutions, formation of ammoniates, ammonolysis, etc., parallels the behavior of aquo-compounds towards water in a truly remarkable manner; in fact, ammonia enjoys the distinction of being an even more perfect solvent than water, in that it forms conducting solutions of numerous metals (alkali and alkaline earth metals) in which the anion is the electron itself, associated with ammonia, and in that it dissolves a host of organic compounds insoluble in water.

One naturally inquires why this sort of thing should be restricted to water and ammonia, and why other liquids—or liquid gases or even melted solids—should not also form the basis of a hitherto unknown chemistry. Liquid silicon dioxide, while a derivative of water, may nevertheless be looked upon as such a substance, and we may expect as one of the results of the recent success in the preparation of large amounts of liquid silica a large increase in our knowledge of the chemistry of the silicates; the laboratory of geochemistry and the workers in the glass industry have of course already made notable contributions in this field. Among the liquid gases that have been investigated along this line, such as hydrogen sulfide, hydrogen fluoride, hydrogen chloride, etc., more or less insurmountable obstacles oppose themselves—hydrogen fluoride attacks our customary apparatus, though there is no reason why the optically clear Bakelite developed some years ago should not be used in the pursuit of this subject; hydrogen sulfide, hydrogen chloride and many others, on the other hand, refuse to dissolve anything, and so prevent us from continuing the study.

Among these other substances, one that is important commercially because of its use in the preparation of certain organic compounds and in the synthesis of anhydrous chlorides from minerals, and is therefore readily obtainable, is phosgene, or carbonyl chloride, $COCl_2$, known since 1811, when it was discovered by John Davy, brother of the illustrious Sir Humphry. Phosgene may be looked upon as the acid chloride of carbonic acid, and in its reactions it behaves in this way. It is an excellent solvent for organic compounds; as an acid chloride it is very reactive in this field, and being an easily condensible gas (it boils at 8° C.) and very soluble in benzene and toluene, it may be used as a pure liquid, as a gas or as a solution in any one of a variety of solvents. At high temperatures it is likewise very reactive—probably because it dissociates, giving carbon monoxide and chlorine, and it has been found possible to open up difficult minerals by its use, to prepare anhydrous chlorides from the oxides, etc. But liquid phosgene is practically inert towards inorganic compounds and the metals. Sodium, potassium, calcium, magnesium, even mercury, remain perfectly bright in liquid phosgene, even after prolonged exposure, except as already mentioned at elevated temperatures. Among inorganic compounds, the chlorides of the non-metals and of the metalloids and aluminium chloride are soluble in liquid phosgene.

The solution of aluminium chloride in phosgene has important properties: metals are corroded or dissolved by this solution, with liberation of carbon monoxide; metallic oxides, carbonates and sulfides are attacked, with liberation of carbon dioxide or carbon oxysulfide, as the case may be, and in certain cases the solid product of the reaction is soluble, so that the reaction goes on vigorously. The solution contains a more or less soluble chloraluminate of the metal used, which may be more or less dissociated into aluminium chloride and the chloride of the other metal; on evaporation of the solvent, or on cooling the solution, crystals of a chloraluminate containing phosgene of crystallization are deposited; for example, the calcium salt has the formula $CaAl_2Cl_8 \cdot 2COCl_2$.

The explanation is simple, and entirely analogous to the mechanism of the solution of aluminium or zinc by a water solution of sodium hydroxide; *phosgene is fundamentally reactive,* but the chlorides of most metals are entirely insoluble; the double chlorides with aluminium, the chloraluminates, on the other hand, are much more soluble, and the protective film of chloride which forms on the surface of the metal, oxide, carbonate or sulfide is dissolved in the presence of aluminium chloride as chloraluminate, and the reaction proceeds.

There is no *a priori* reason why other types of soluble complex salts should not exist, not only in the case of phosgene, but for other solvents. And the chemistry of these systems simply awaits the discovery of the type of compound peculiar to the system which is soluble enough to permit the inherent reactivity of the solvent to manifest itself.

Albert F. O. Germann

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[1] Presented at the Stanford University meeting of the Pacific Division of the American Association for the Advancement of Science, June 26, 1924.

THE AMERICAN CHEMICAL SOCIETY[1]

DIVISION OF ORGANIC CHEMISTRY

R. R. Renshaw, *chairman*

J. A. Nieuwland, *secretary*

The relative reactivities of the hydroxydehydrogen atoms of certain alcohols: JAMES F. NORRIS and A. A. ASHDOWN. The rates at which several alcohols react with p-nitrobenzoyl chloride in ether solution were determined. The second order velocity constant of methyl alcohol at 25° C. was 0.184. Taking this value as 100 the other alcohols give the following numbers: Ethyl 45.0, n-butyl 40.2, n-propyl 35.9, beta-phenyl-ethyl 21.6, isobutyl 16.7, alpha-phenyl-prophyl 10.7, benzyl 9.3, isopropyl 5.4, secondary butyl 4.0, tertiary butyl 1.46. The significance of these numbers will be discussed.

The dissociation into free radicals of derivatives of dixanthyl: J. B. CONANT and A. W. SLOAN. The salts of 9-benzylxanthenol on reduction with vanadous chloride yield dibenzylxanthyl, which, like diphenyldixanthyl, dissociates with the formation of a free radical. The molecular weight determinations in benzene indicate about 10 per cent. dissociation; the substance rapidly absorbs oxygen, forming a peroxide. Dibutyldixanthyl prepared in a similar manner shows none of the characteristic reactions of a free radical, and like the parent substance dixanthyl appears to be undissociated, although it absorbs oxygen very slowly. The influence of the benzyl group in causing dissociation is of interest in connection with the problem of the stability of trivalent carbon compounds.

A comparative study of the Kjeldahl-Gunning-Arnold and boric acid method for the determination of nitrogen: KLARE S. MARKLEY and RAYMOND M. HANN. The paper summarizes a series of experiments designed to show that the boric acid method, which utilizes a 4 per cent. solution of boric acid as an absorption medium for the liberated ammonia following its conversion to $(NH_4)_2SO_4$ by digestion with sulfuric acid containing 10 per cent. P_2O_5 and subsequent release with an excess of alkali, is equally as accurate as the official Kjeldahl-Gunning-Arnold method of the A. O. A. C. Tables will be shown giving comparative results on soils, solutions, alkaloids and organic compounds; a discussion of the indicators used and the advantages of the boric acid method in regard to economy of time, materials and standard solutions will also be given.

The ketenic decomposition of the ketones: CHARLES D. HURD and WILLIAM H. TALLYN. The optimum conditions for the preparation of ketene from acetone have been ascertained. Consistent yields of 35 per cent. are obtainable, and yields considerably higher than this have been obtained. Acetyl acetone, pinacoline and diacetyl have all been subjected to pyrogenic decomposition. Theoretically these represent three very interesting types, when the possibilities of ketene fission are considered.

[1] Ithaca Meeting, September, 1924.

The beta-chlorovinyl arsine reaction and further derivatives: W. LEE LEWIS and H. W. STIEGLER. As previously published (*Jour. Ind. and Eng. Chem.*, March, 1923) it is believed that the catalyst complex in this reaction is $Al(CHCl = CHCl)_3As$, formed first by the addition of three moles of acetylene to one of aluminum chloride with subsequent addition of dissociated arsenic chloride to this. If this is correct then the halogen on the arsenic will determine the halogen in the final arsine after the intermediate compounds are hydrolyzed. Experimentally it was found that arsenic bromide gave bromo arsines, and arsenic chloride gave chloro-arsines, regardless of whether aluminum bromide or chloride was used. The study is being extended to the action of mercury halides in catalyzing unsaturated reactions. Among the derivatives of the chloro-vinyl arsines prepared were: Beta-chloro-vinyl-arsenious sulfide; 7-beta-chloro-vinyl-7, 12-dihydro-gamma-benzo-phenarsazine; bis-beta-chloro-xinyl cyanide (and sulfide); bis-beta-chlorovinyl-methyl (and ethyl) arsine; tris-beta-chlorovinyl-methyl-arsonium iodide.

The preparation of alpha oxy-indole propionic acid and its halogen derivatives: E. C. KENDALL and A. E. OSTERBERG. Alpha oxy-indole propionic acid is prepared from its hydro derivatives by oxidation in glacial acetic acid followed by reduction of the resulting bromo derivatives with sodium amalgam in alkaline solution. It is precipitated from the alkaline solution by acids. It can not be reduced with sodium amalgam to the di and tetra hydro derivatives. In water it adds on bromine to the N, which then migrates to No. 6 carbon. More bromine will give the 4, 6, dibromo. With excess bromine it will take up seven bromine atoms. The relation of these compounds to thyroxin will be discussed.

Some condensation products of furfural: S. A. MAHOOD and S. B. JORDAN. Heating furfural with benzene in the presence of zinc chloride causes polymerization of the furfural into a solid. Unlike the condensation of benzaldehyde with benzene which forms triphenyl-methane, no evidence of the analogous compound, diphenyl-furyl-methane, was found. From the data obtained the product is a polymer of furfural. Phosphorous halides give a similar product rather than fural halides. Furfural with phenyl-magnesium-bromide yields an addition product which with water gives an unstable oil which is apparently phenyl-furyl-carbinol. All attempts to esterify it, however, were unsuccessful and led to polymerization products.

The relation between the structure of organic halides and the reactivity of the halogen atom: J. B. CONANT, W. R. KIRNER and R. E. HUSSEY. The velocity constant of the reaction $RCl + KI \rightarrow RI + KCl$ in absolute acetone has been measured. The temperature coefficient of the reaction seems to be nearly the same for all substances studied. Ethyl chloride is about 2.5 times as reactive as n-propyl chloride, normal chlorides of higher molecular weight have about the same reactivity as propyl and butyl chlorides; secondary and tertiary halides are less reactive. The influence of so-called negative

groups such as C_6H_5, C_6H_5CO, CN, etc., can be expressed by the equation:

$$2 \log R = \log K_A - \log K_{H_2O} = \log K_{NH_3} - \log K_B,$$

where R is the relative reactivity of RCH_2Cl referred to butyl chloride, K_A the dissociation constant of AOH as an acid, and K_B the dissociation constant of ANH_2 as a base.

Positive halogen in organic compounds. II—The propinyl halides: LLOYD B. HOWELL and GAYLORD JOHNSON. Satisfactory methods have been found for preparing $CH_3-C\equiv C-Br$ and $CH_3-C\equiv O-Cl$. Failure of previous workers using methods successful for $CH_3-C\equiv C-I$ (halogenating silver allylide suspended in water) was probably due to interfering oxidation and halogenation of the triple bond. Preliminary study of these propinyl halides and also review of Nef's work with $CH_3-C\equiv C-I$ indicates his conclusion that compounds of type $R-C\equiv C-X$ are non-toxic, unexplosive and generally unreactive (in contrast to type $X-C\equiv C-X$) is not justified. Chloro-allylene and bromo-allylene are as pronouncedly nauseating, toxic, spontaneously inflammable and chemo-luminescent as are the halogen substituted acetylenes. Reactions of the propinyl halides indicate distinct positive polarity of the halogen atom present.

A modification of organic combustion analysis adapted to volatile liquids (Lantern): L. M. DENNIS and F. E. HANCE. In the analysis for carbon and hydrogen the usual train of reagents and combustion tube containing copper oxide are used. Suction is applied at the exit of the train, the copper oxide is heated, the sample in a small, sealed tube, having a constricted neck, is dropped in a U tube placed in the chain at the entrance of the combustion chamber. The neck of the sample tube is broken by a glass rod, the stopper being quickly replaced. An electrically heated oil bath is used to maintain the sample at about 20° below its boiling point, the vapor picked up by air, passing by a long thin tube, through the combustion tube, directly to the heated copper oxide. Condensation of the sample in the cooler portions of the combustion tube is prevented by a secondary stream of air which is drawn into the tube at the forward end.

Some interesting facts concerning the ultra-violet absorption spectra of certain organic compounds (Lantern): HELEN L. WICKOFF, C. E. BOORD and A. W. SMITH. The ultra-violet absorption of benzene, monobromobenzene, paradibrombenzene, monochlorobenzene, paradichlorobenzene, cyclohexene, 1-methylcyclohexene, 3-methylcyclohexene, diethylether, dinormalpropylether, dinormalbutylether, methylnormalamylether and other related derivatives have been studied in a comparative way. The complexity of the ultra-violet absorption pattern of these derivatives seems to be a function of the molecular symmetry. The absorption patterns of all these substances are very similar and certainly can not, in some cases, be attributed to the oscillation of double bonds.

Thymolsulfonephthalein, the intermediate acid (p-hydroxy-m-isopropyl-o-methyl-benzoyl benzene-o-sulfonic acid) and some of their derivatives: W. R. ORNDORFF and R. T. K. CORNWELL. Preparation of thymolsulfonephthalein and dithymyl-o-sulfobenzoate from the chlorides of o-sulfobenzoic acid and thymol. Preparation of thymolsulfonephthalein and the intermediate acid (p-hydroxy-m-isopropyl-o methyl-benzoyl benzene-o-sulfonic acid) from the anhydride of o-sulfobenzoic acid and thymol. Action of ammonia on the intermediate acid, its barium salt and the dibenzoate. Conversion of the intermediate acid by heat alone and by heating with thymol into thymolsulfonephthalein. Action of ammonia on thymolsulfonephthalein. The monosodium and disodium salts of thymolsulfonephthalein, the diacetate, the dibenzoate, the dimethyl ether, the aniline derivative. Dibromothymolsulfonephthalein and its diacetate.

The chemistry of Jaffe's reaction for creatinine. II—The effect of substitution in the creatinine molecule: ISIDOR GREENWALD. In a previous publication, it has been shown that Jaffe's reaction for creatinine is due to the formation of red tautomer of creatinine picrate. The following derivatives of creatinine do not give the reaction: dimethylolcreatinine, benzylidine acetylcreatinine, *benzylidine creatinine and tribenzoylcreatinine.* Reduction of benzylidenecreatinine with zinc and acetic acid gives a solution which gives Jaffe's reaction and from which *benzyl creatinine picrate* was isolated. Jaffe's reaction is given by methylcreatinine, benzoylcreatinine and methylglycocyamidine (isocreatinine). There appear to be two forms of benzoylcreatinine. (Substances italicized are new.)

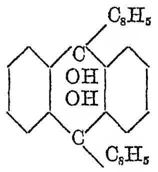
Ketene in the Friedel and Craft's reaction: CHARLES D. HURD. Ketene, in the presence of aluminum chloride, will convert several types of aromatic compounds, such as benzene, anisole, naphthalene, etc., to ketones. A mixture of ketones nearly always results, and it seems that in many cases more than one "$-COCH_3$" group is introduced. Ketene forms a white addition compound with aluminum chloride, suspended in CS_2. When aromatic compounds are added to it, HCl is evolved and ketones are formed as before.

The preparation of di and tetra-hydro oxy-indol propionic acid: E. C. KENDALL and A. E. OSTERBERG. 1-alpha-glutaric acid 2-keto-cyclohexane reacts with ammonia in absolute alcohol to form tetra-hydro alpha oxy-indol propionic acid. In glacial acetic acid bromine oxidizes this to 3, monobromo-5, 6, di-hydro alpha oxy-indol propionic acid. The properties of these two derivatives of alpha oxy-indol and their relation to thyroxin will be discussed.

Derivatives of 3, 4-diamino-phenyl-arsonic acid: W. LEE LEWIS and H. S. BENT. The study had for its main objective, which was achieved, the preparation of the arseno compound of sulfoxilated tryparsamide (As C_6H_3 (NH CH_2 $CONH_2$)NH $CH_2-OSONa)_2$. A preliminary study of the stability of the arsonic radicle to heat was necessary, as well as the reactivity of the diamino-phenyl-arsonic acid to various aliphatic and aromatic acid chlorides, chloro-carbonates, alcohols, etc. Of interest

are: N-(Phenyl-1-amino-4-arsonic acid) glycineamid; 1, 2-dihydro-3-amino-6-arsono quinoxaline; 1, 2-dihydro-3-hydroxyethylamino-6-arsonoquinoxaline; N-(phenyl-4-arsonic acid) amino malonamide; 1, 2-dihydro-2-formamide-3-amino-6-arsono quinoxaline.

9, 10-diphenyl anthracene: LLOYD B. HOWELL and E. E. DUNLAY. Attempted inner dehydration of:



resulted in reduction to 9, 10-diphenyl anthracene, a bright yellow solid. When, however, this hydrocarbon is made by method in literature (reduction of above diol by KI) a white solid results. Both forms melt alone or mixed at 261°, oxidize directly to original diol, upon chlorination give the same 9, 10-dichloro compound, but by no physical process could either modification be changed to the other. No adequate explanation of such two forms of 9, 10-diphenyl-anthracene is evident. The original diol made from anthraquinone and phenyl magnesium bromide (yield 10 per cent. in older literature m. p. 240–1° and 247°) was produced in yields of 80 to 90 per cent. of high purity (m. p. 263°) by merely adding a solid solvent for anthraquinone.

A new technique for preparing and handling zinc diethyl: L. M. DENNIS and F. E. HANCE. This article deals with a new method of preparing, purifying and handling zinc diethyl. Due to its spontaneously inflammable character, this reagent is handled in a closed chain of apparatus in a stream of carbon dioxide. Reaction is brought about between a zinc-copper couple and ethyl iodide. During this reaction ethyl iodide is refluxed against a slight pressure of carbon dioxide, this portion of the apparatus being vented to the room through a mercury trap. The product, zinc ethyl iodide, is converted to zinc diethyl and is passed along the apparatus by distillation from the zinc-copper reaction mixture. By fractional distillation the product is purified and the constant boiling alkyl is delivered to receptacles for further treatment, while the lower and higher boiling portions are diverted to another container in the chain. These operations are conducted in their proper sequence without exposing the alkyl to room air. The variations of gas pressure during the refluxing operation, in subsequent distillations and in the movement of the alkyl through the train, were all controlled by a series of simple mercury traps, by-pass connections and a vacuum oil pump. The entire apparatus may be readily constructed from ordinary laboratory material.

Some derivatives of p-hydroxy-methyl benzoic acid: F. H. CASE. In the esters of p-hydroxy-methyl benzoic acid, the local anesthetic effect of benzyl alcohol should be combined with that of aromatic esters in general. The object of this work has been the synthesis of such esters and some of their derivatives. p-hydroxy-methyl benzoic acid has been synthesized by a new and convenient method. Its ethyl, propyl, butyl, isobutyl and benzyl esters have been prepared, as well as the urethane, phenyl urethane, benzoyl and amino benzoyl derivatives of the ethyl ester. The benzyl and diethyl amino ethyl esters of p-ethoxy-methyl benzoic acid are described.

The two crystalline forms of glycine: C. A. BRAUTLECHT and W. W. PURDY. The results of a large number of experiments are given to determine whether any difference exists between the needle and plate forms of glycine when treated with sulfur dioxide alone, and in the presence of water-free liquids, carbon disulfide alone and in the presence of water-free liquids and acetyl chloride. As in the experiments with hydrogen chloride and bromine (C. A. Brautlecht and N. F. Eberman, *J. A. C. S.*, 45, 1924), using all means possible, no chemical difference between the two forms can be detected. Water brings about an equilibrium between the two forms and sulfur dioxide, carbon disulfide and acetyl chloride react with glycine only in the presence of water or atmospheric moisture.

The addition compounds of di-bromo-o-toluidine with metallic salts: RAYMOND M. HANN and G. C. SPENCER. A series of addition compounds prepared to study the effect of certain metals in organic combination upon the determination of nitrogen by the boric acid method. Dibromo-o-toluidine combines with $HgCl_2$, $ZnCl_2$, $CdCl_2$, $CdBr_2$ and certain other metallic compounds to give derivatives of the type $2\,C_6H_2(CH_3)(Br_2)NH_2 — MX_2$. Antimony trichloride combines in the ratio 1: 1. Comparison of results for nitrogen determination shows the boric acid method applicable to this class of compounds.

Nitration from a physical-chemical viewpoint: P. M. GIESY. Since the addition of sulfuric acid to a mixture of water and nitric acid raises the vapor pressure of the nitric acid, it must also raise the concentration of nitric acid dissolved in any immiscible liquid in equilibrium with the mixture and should therefore aid in the nitration of such a liquid. The suggestion is made that all mixed acids having equal vapor pressures of nitric acid should behave the same in nitrating, unless sulfuric acid dissolves sufficiently in the organic liquid to lower the vapor pressure of nitric acid from it.

The crystallography and optical properties of substituted 3-methoxy-4-hydroxy-benzaldehydes: RAYMOND M. HANN and EDGAR T. WHERRY. The crystallography of a series of substituted 3-methoxy-4-hydroxy-benzaldehydes is discussed from the chemical side. The effect of atomic volume upon crystal structure is pointed out. Topic axes are calculated and the resultant data included. Finally the optical properties of the derivatives are tabulated and a scheme for their separation and identification by optical means appended.

Reactions of divinylacetylene: J. A. NIEUWLAND. Reactions of divinylacetylene that gives additional proof of the formula ($CH_2 \equiv CH — C \equiv C — CH = CH_2$) of this acetylene polymer have been worked out. A tetrabromide has been prepared and purified (M. P. 87°). A hexa-

bromide, the highest halogen containing derivative was obtained (M. P. 118°). Its formula is $CH_2Br - CHBr - CBr = CBr - CHBr - CH_2Br$. No octabromide could be obtained. The most interesting reaction of divinylacetylene is that by which formaldehyde is obtained by passing air into the warm hydrocarbon in the presence of $CaCl_2$ as a catalyst. Action of other reagents such as NOCl, N_2O_3, NO_2, Cl_2, I_2, H_2SO_4, HBr, CuCl (neutral in NH_4Cl or alkali chloride solutions). Polymerization products. In general it is even more reactive than C_2H_2. (Note on the preparation of pure dichlor ethylene ($CHCl = CHCl$).)

Preparation of several phenyl-alkyl hydantoins: T. J. THOMPSON. Several patents have been issued pertaining to the preparation of phenylethyl hydantoin, Nirvanol, a soporific introduced in 1917. These patents indicate three general lines of procedure, which may be used to synthesize 4, 4-aryl-alkyl hydantoin: (1) The reaction of carbonyl chloride with disubstituted amino-acetamid; (2) the reaction of alkali cyanate with disubstituted amino-aceto-nitril; (3) the reaction of alkaline hypohalites with disubstituted cyano-acetamides and malonamides. In this investigation phenylethyl hydantoin and four other substituted hydantoins, phenylpropyl, phenylisopropyl, phenylbutyl and phenylisobutyl hydantoin have been prepared by each of the last two methods. Phenylpropyl and phenylethyl hydantoin are mentioned in the patent literature. Preliminary tests indicate that the general physiological reaction of phenylpropyl and phenylisobutyl hydantoin is about the same as phenylethyl hydantoin Nirvanol, whereas phenylisopropyl and phenylbutyl have no action physiologically.

Aryl-arseno-acetic acids: C. SHATTUCK PALMER. Attempts to produce compounds of the type $RAs = AsCH_2COOH$ by simultaneous low-temperature reduction of an aryl arsonic acid and arsono-acetic acid gave mainly symmetrical aromatic arseno-compounds and arseno-acetic acid. This result suggested certain experiments now in progress to confirm the writer's view that the action of a primary arsine on a primary arsine oxide produces not by direct elimination of water to give the unsymmetrical arseno-compound but by formation of two symmetrical arseno-compounds which on further heating rearrange. An aryl-arseno-acetic acid is formed when molecular equivalents of an aryl water-soluble arseno-compound and sodium arseno-acetate are heated in slightly alkaline solution. (By title.)

Polyhydroxy methyl anthraquinones. IV—Condensation of opianic acid with substituted phenols and orientation in the preparation of anthraquinone: R. A. JACOBSON and ROGER ADAMS. Aromatic aldehyde acids condense with various p-bromo phenols by means of sulfuric acid to give substituted phthalides where condensation has taken place ortho to the hydroxyl group. The phthalides thus produced are readily reduced with zinc and sodium hydroxide to benzyl benzoic acid which can be converted to anthraquinones.

Molecular rearrangement in the acetylation of peri-aminonaphthol: L. CHAS. RAIFORD and E. P. CLARK. The study of mixed o-acyl-N-acyl derivatives of aminophenols has shown (*J. Am. Chem. Soc.*, *45*, 1738 (1923) and *46*, 430 (1924)) that when acyl radicals differ very much in weight and the reacting groups (amino and hydroxyl) are attached to adjacent carbon atoms (ortho), migration of acyl may occur under certain conditions. When these groups are on para carbon atoms this migration has not been observed. It has now been shown that when these groups are in the pori position, rearrangement may occur. Thus, benzoylation of 8-acetylamino-1-hydroxynaphthalene gives 8-benzoylamino-1-acetyl-oxynaphthalene. This supports the theory of Kaufler (Ber., *40*, 3250 (1907)) used to explain the observations of Kaufler and Karrer (*ibid.*, 3262) on 2, 7-naphthalenediamine.

Isophenolphthalein and some of its derivatives. A new class of phthaleins: W. R. ORNDORFF and W. R. BARRET. Ortho-para-phenolphthalein has been prepared by condensing phenol with o-hydroxybenzoyl-o-benzoic acid. It yields triclinic crystals which melt at 200° C. Its solution changes with alkalis from colorless to yellow at pH 8.4. The useful range is between pH 8.4 and pH 12.0 with a color change from yellow to purple. It has no laxative effect. Its solubilities and absorption spectra have been compared with those of phenolphthalein. Its reactions with bromine, iodine, ammonia, hydrazine, acetic anhydride, hydrohylamine, etc., are similar to those of phenolphthalein. When fused with caustic potash, the isophthalein yields o-p-dihydroxybenzophenone and benzoic acid. On reduction it yields isophenolphthalein and p-hydroxy-triphenylmethane carboxylic acid. This is the beginning of a series of new phthaleins which are under investigation in this laboratory.

Platinum oxide as a catalyst in the reduction of organic compounds. VII—A study of the effects of numerous substances on the platinum catalysis of the reduction of benzaldehyde: WALLACE H. CAROTHERS and ROGER ADAMS. (1) When ferrous chloride is added to pure catalyst which has been completely deprived of its activity by shaking with aldehyde, none of the activity is restored to the platinum, but if the mixture which contains the exhausted platinum is shaken with air, either before or after the addition of the ferric salt, the activity of the catalyst is partially restored and the restoration is permanent. (2) The power to accelerate the platinum catalysis of the reduction of benzaldehyde was found to be common to all the compounds of iron examined, namely, metallic iron, ferrous hydroxide, ferric hydroxide, ferric oxide, ferric chloride, ferrous chloride, ferrous sulphate, ferric acetate and ferric nitrate. (3) A variety of salts of other metals have also been tested in their effect upon platinum catalysts of the reduction of benzaldehyde. Manganese chloride and acetate, cobalt chloride and acetate, nickel chloride and acetate and chromic chloride are powerful accelerators. A variety of other salts had either no effect or only a slight effect. (4) Hypotheses which might account for the mechanism for the promoter effects have been suggested.

R. R. RENSHAW,
Chairman

SCIENCE

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CONTENTS

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THE CHEMISTRY OF VITAMINS[1]

THE existence of substances to which the name vitamin has been given was first recognized some fourteen years ago, and since that time much information has been obtained concerning their source, distribution, physiological and other properties, but comparatively little in regard to their chemical structure. This has been due to the fact that until recently it has not been possible to isolate any one of them in a relatively pure condition.

The difficulties in connection with the purification of vitamins have been due, among other things, to the complex character of the raw materials in which they occur, the small percentage present, the destructive effect of many of the reagents and laboratory manipulations used for their fractionation and finally, the want of a reliable chemical test by which the success of the purification steps could be controlled. In the absence of a chemical test it has been necessary to rely upon feeding experiments, which require much time and do not give uniformly dependable results.

In spite of the difficulties which have and will be encountered in the chemical study of vitamins, it is one of the most attractive problems which can occupy the attention of an investigator. The several vitamins perform essential functions in the nutrition of animals and on them depend growth, health, reproduction and completion of the life cycle. There is evidence that they are not of excessively complex or fugitive character, and the prospects of success in determining their chemical constitution is encouraging. Such information when obtained will undoubtedly contribute more to human welfare than can now be appreciated.

The proper selection, preparation and conservation of the food supplies of man and of domestic animals is intimately connected with a knowledge of the chemical properties of vitamins. Future modifications of food products will undoubtedly exceed those of the past. A comparison of the foodstuffs of primitive populations with the package products of to-day will give a faint hint of the extent of the improvements which may be expected in the future.

The modification of natural food products for the purpose of conservation and economical preparation for consumption is a field of endeavor which is deserving of unlimited effort. When there is also con-

[1] Presented before the Division of Medicinal Products at the 67th meeting of the American Chemical Society, April 22, 1924.

sidered the possibility of eliminating specific diseases and reducing the prevalence of others by increasing resistance to infections, through a knowledge of vitamins, the importance of research on their chemistry can not be overestimated.

On account of the very small amounts of vitamin required for striking physiological effects, it has been suggested that they are related to enzymes. Acceptance of this view has undoubtedly turned many from the problem, since the possibility of isolating an enzyme appears now to be very remote. Fortunately, the evidence is increasing that vitamins are less complicated structures than enzymes. The work which it is my privilege to report to-day furnishes additional proof that the characteristic physiological activity ascribed to vitamin B resides in a molecule of reasonably simple composition.

Before directing your attention to the work on vitamin B I wish to summarize briefly the status of current chemical studies on the other recognized vitamins.

VITAMIN A

Considering first the so-called fat soluble vitamin A, which has been found to be especially abundant in cod liver oil, it is now well established that by saponification of the oil, the activity remains unimpaired in the non-saponifiable fraction. This latter is largely composed of cholesterol. In addition there are present lipochromes, fatty acids and substances which give a characteristic blue violet color when the sample is dissolved in petroleum spirit or similar solvent and a drop of sulfuric acid is added. Drummond and Watson[2] have obtained evidence that in liver oils there is an association between the presence of vitamin A and the power to give the typical color reaction.

In an attempt to isolate vitamin A from the non-saponifiable fraction of cod liver oil, Takahashi[3] obtained a semi-crystalline product by the following procedure. The oil was first saponified with alcoholic potassium hydroxide and insoluble calcium soaps precipitated by addition of calcium chloride. The mixture was then saturated with carbon dioxide, after which the alcohol was removed, and the residue extracted with ether. The ethereal extract was treated with dilute hydrochloric acid and the liberated fatty acids separated from it with the aid of alkaline aqueous alcohol. The ether was then distilled off and the residue dissolved in methyl alcohol. This solution was cooled and the cholesterol which separated was removed by filtration. Additional impurities were eliminated by treatment with digitonin and the final filtrate concentrated to a viscous syrup. This was dissolved in a small quantity of methyl alcohol and cooled to — 20° C. From this solution there separated a semi-crystalline product which, when tested on mice, was active in daily doses of 0.08 milligram. It contained C, H and O but no N. Its properties indicated that it was of aldehydic nature.

These experiments are very encouraging and show that a more intimate knowledge of the chemistry of vitamin A only awaits additional experimental work.

VITAMIN C

In regard to the antiscorbutic vitamin C no exhaustive work on its isolation and identification has, so far, been reported. The ease with which it is destroyed by alkalinity and oxidation makes experiments with this vitamin very difficult. Attention should, however, be called to the experiments of Bezssonoff[4] on cabbage juice. His process consists in subjecting cabbages to hydraulic pressure and immediately treating the expressed liquid with neutral lead acetate. The excess of lead is removed from the solution with hydrogen sulfide and the filtered liquid evaporated to dryness at 35° under diminished pressure. The final product is dried over sulfuric acid in a vacuum. There is obtained 2.5 grams of slightly yellowish very hygroscopic powder from each 100 cubic centimeters of the cabbage juice. An apparatus is used which permits all the operations to be conducted in the nearly complete absence of oxygen. The product contains 33 to 46 per cent. of reducing sugars and 52 to 65 per cent. of total sugar. There is present about 7.5 per cent. of ash. It is free of fats and proteins and is active for guinea pigs in daily doses of 0.1 gram.

Recent work by Zilva[5] on the chemical character of the antiscorbutic fraction of desiccated lemon juice has shown that the invert sugar, which it contains, can be eliminated almost completely, without destroying the activity of the solution, by fermenting with yeast in an atmosphere of carbon dioxide. Thus he has obtained a product containing fewer impurities than any potent antiscorbutic so far described.

VITAMIN D

The latest announcements of interest in connection with the chemistry of vitamins are those concerned with the recently identified vitamin D. This product is characterized by its power to accelerate the growth of yeast and is probably identical with the "bios"

[2] J. C. Drummond and A. F. Watson, *Analyst*, 47, 341–9 (1922).

[3] K. Takahashi, *J. Chem. Soc.* (Japan), 43, 828–30 (1922); 44, 580–605 (1923).

[4] N. Bezssonoff, *Compt. rend.*, 175, 846 (1922).

[5] S. S. Zilva, *Biochem. J.*, 17, 410, 415 (1923); 18, 182 (1924).

of Wildiers.[6] Three groups of investigators have recently reported the isolation of crystalline or otherwise well-characterized compounds, which greatly promote the growth of yeast. The most surprising of these is the work done at the University of Toronto and reported by W. Lash Miller.[7] According to these experiments an infusion of malt house "combings," when purified by addition of alcohol and the filtrate precipitated with barium hydroxide, gave two products, neither of which was separately active, but a mixture of the two promoted the growth of yeast almost as well as did the original infusion. The fraction which was carried down by the baryta was designated "Bios I" and the one left dissolved was called "Bios II." The outstanding behavior of each was described, as well as their relative distribution in various products. It was later found that Bios II could be divided into two fractions, thus showing the presence of at least three separable constituents, all of which must be present in the medium to accelerate the growth of yeast.

A more recent announcement is that of Eddy, Kerr and Williams,[8] who report the isolation of a crystalline substance having the properties of bios. The essential feature of their method consists in a preliminary purification of autolyzed yeast by Fuller's earth, which removes other substances than bios, followed by the use of colloidal iron hydroxide. This latter carries down the bios, and can later be dissolved, leaving the bios free of contaminating ions. These authors expect to report more fully on their work at the present meeting.

Finally, attention should be called to a paper by Suzuki and Suzuki,[9] in which it is stated that vitamin D was separated from vitamin B by the use of aluminium cream and other precipitating agents.

VITAMIN B

Returning now to studies on the isolation of the antineuritic vitamin B, it should be mentioned that a very complete summary of the experiments made up to 1922 is given by Professor Sherman in his book "The Vitamins."

The original method of Funk, which has been followed more or less closely by the majority of those who have devoted themselves to this problem, consists in extracting the raw material with acidified water or aqueous alcohol. The resulting extract is concentrated and, after removal of extraneous material, the solution is subjected to successive precipitations with such reagents as phosphotungstic acid, silver nitrate, tannic and picric acids. In all cases in which crystalline products were finally obtained they proved to be well-known compounds, which did not possess the physiological properties of the antineuritic vitamin, or else the activity which they exhibited could be accounted for by impurities still present. Recent work following this same procedure is reported by Tsukiye.[10] A gray white powder, curative for hens in doses of about 10 milligrams, was finally obtained. It exhibited great similarity to histidine in most respects except the diazo reaction. As compared with pyrimidine bases and allantoin, it possessed some like properties and others which were different.

A consideration of the general procedure mentioned above shows that the desired separation of the vitamin from the numerous substances with which it is associated depends in the first place upon a fractional solubility in water or alcohol, and secondly upon the formation of insoluble complexes of the vitamin with certain precipitating reagents.

It is apparent that the first step, which depends upon solubility differences, is only slightly selective. Consequently any improvement at this point would be a distinct advantage. Realizing this and knowing of the discovery by Professor John Uri Lloyd that Fuller's earth exerts a selective adsorption of alkaloids, I tested, several years ago, the adsorptive power of this reagent for the antineuritic vitamin, and luckily found that it could be successfully used for separating this vitamin from the larger part of the substances with which it may be associated in solution. The vitamin-Fuller's earth adsorption complex or "activated solid," as I have called it for convenience, undoubtedly contains the vitamin in a purer form than any other product available as a starting point for isolation experiments.

Fortunately the active material can be recovered from its combination with the Fuller's earth by a relative simple procedure,[11] and the concentrated extract thus obtained has, in my opinion, advantages for precipitation experiments far superior to those of extracts prepared in any other way. All my subsequent work has, therefore, been based upon the utilization of this remarkable power of Fuller's earth, and any measure of success that may have been attained is due to this exceptionally favorable initial step of the process. It is interesting to note in this connection that selective adsorption has recently been utilized with great advantage in the purification of insulin, in which case charcoal was used as the adsorbent.

[6] Wildiers, "La Cellule," 18, 313 (1901); Amand, *ibid.*, 21, 327 (1904); Devloo, *ibid.*, 23, 361 (1906).

[7] W. Lash Miller, SCIENCE, 59, 197, 1924.

[8] March 26th meeting of the Society for Experimental Biology and Medicine, New York.

[9] U. Suzuki and B. Suzuki, *J. Chem. Soc.* (Japan), 44, 225 (1923).

[10] S. Tsukiye, *Biochem. Z.*, 131, 124–39 (1922).

[11] Seidell, *J. Am. Chem. Soc.*, 44, 2043 (1922).

Physiological Tests

As mentioned previously, the circumstance which has perhaps retarded most the isolation of vitamins has been the necessity of depending upon physiological tests for controlling the fractionation procedures. In the early days the test for antineuritic activity was made by restricting a bird to a diet of polished rice until symptoms of polyneuritis developed, and then administering the unknown sample and noting the effect. It was later recognized that these curative tests were subject to unaccountable irregularities and many erroneous conclusions had been drawn. Gradually it has become evident that protective tests are much more reliable. In these cases the bird is placed on a vitamin B free diet and simultaneously given, at regular intervals, measured doses of the sample to be tested. A decline in weight indicates that the unknown contains less vitamin than required for maintenance. It has furthermore been found[12] that the indications of this test are even more trustworthy, if the birds are kept on a vitamin-free diet and given such doses of a standard vitamin preparation ("activated solid"), as are just sufficient to prevent loss in weight. When now the standard vitamin is replaced by the sample to be tested, any diminution in vitamin content below that of the standard is promptly and uniformly indicated by a loss in weight. Using pigeons, accurate conclusions as to the activity of a given sample can be drawn within a period of ten days, and in cases where the dose is markedly inadequate, an unmistakable decline in weight occurs within six and sometimes within four days. By this procedure the birds can be used repeatedly for the tests, provided care is taken that no more than moderate losses in weight are permitted. Many of the pigeons used for the tests depicted in the charts which follow have been kept for more than a year on an exclusive diet of polished rice, supplemented only by highly purified vitamin B preparations. It is interesting to note in this connection that as the pigeon reaches old age its vitamin requirement becomes less. Pigeons of three or more years may sustain no loss in weight when receiving only one half the vitamin required to maintain a one-year-old pigeon.

Silver Precipitation

The first precipitant which was used for removal of the active constituent of the vitamin extracts, prepared as above outlined, was silver nitrate.[13] Although the experiments showed that the active material was undoubtedly precipitated, especially by ammoniacal silver nitrate, it was found that a large proportion of the vitamin remained in the liquid. Furthermore, it became evident that inactive material was precipitated simultaneously with the active. Thus, on decomposing the silver precipitate and testing the resulting silver free product, there was no significant increase of activity over that of the original extract used for the precipitation. These unfavorable results finally made it necessary to abandon the silver method.

Picric Acid Precipitation

Of the other reagents which were available, picric acid was selected as the most promising. The conditions for the nearly complete precipitation of the active material have been gradually developed and the resulting crude picrate subsequently separated into two crystalline compounds, one of which is highly active. There has thus been obtained for the first time ample quantities of a well-characterized antineuritic compound, suitable for detailed studies of the chemical structure of this one of the at present recognized vitamins.

A preliminary account of the preparation of the active picrate has been recently published,[14] and it will only be necessary at this time to outline briefly the steps involved and call attention to the evidence on which is based the conclusion that a crystalline compound, possessing the antineuritic properties of vitamin B, has been obtained.

Removal of Potassium Salts from the Vitamin Extract

The crude vitamin extract prepared from brewers' yeast by the Fuller's earth method and used for silver precipitations during more than a year had been tested for activity on numerous occasions and its high potency well established. At the time the experiments with picric acid were begun, it was unexpectedly found that a large proportion of a potassium salt was present in the extract. The source of this was undoubtedly the Fuller's earth, from which it would be displaced by a substitution of bases during the extraction with barium hydroxide. The removal of the potassium from the extract was accomplished as follows.

The ash obtained from an aliquot of the extract was titrated with standard sulfuric acid, using methyl orange as indicator. On the basis of this titration an amount of sulfuric acid, equivalent to the total fixed bases, was added to the main portion of the extract and the solution evaporated nearly to dryness. The residue was digested in 66 per cent. ethyl alcohol and the insoluble potassium sulfate removed by centrifugation.

[12] Seidell, Public Health Reports, 37, 1919–23, June 23, 1922.

[13] Seidell, Public Health Reports, 36, 665–70, April 1, 1921; *J. Am. Chem. Soc.* 44, 2045 (1922).

[14] Seidell, Public Health Reports, 39, 294–9, February 15, 1924.

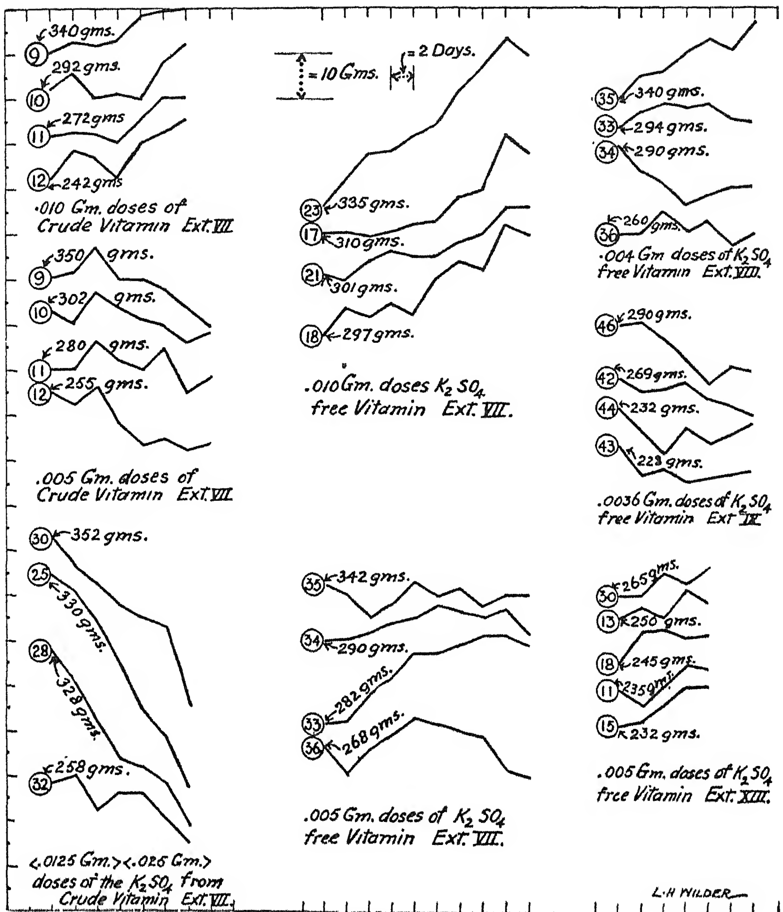

CHART 1

This chart shows the changes in weight of pigeons fed on polished rice and given each second day the specified quantities of vitamin extract, before and after removal of the potassium salts, and also of one sample of the removed K_2SO_4. The figures in circles give the number, and the others the weight of the pigeons at the beginning of the test.

That this procedure exerted no injurious effect on the vitamin is demonstrated by the results in Chart I. An examination of this chart shows that 0.010 gm doses of the crude vitamin extract VII, given on each alternate day, caused pigeons on a diet of polished rice to slowly gain weight. One half this dose was insufficient to prevent the gradual loss in weight of another group. Corresponding doses of the extract from which the potassium salt had been removed gave results indicating increased activity, thus showing that the process for removal of the potassium salt had not caused an appreciable destruction of the vitamin originally present. The potency of three other samples of vitamin extract, freed of potassium salts by the described procedure, is shown by results in the chart. Finally, the inactivity of the removed potassium sulfate is demonstrated by one group of pigeons.

It is to be noted that the pigeons used for the tests recorded in Chart I were of unknown age and had been kept on an exclusive diet of polished rice for some time. It was afterwards found that young pigeons, of one year or less in age, required distinctly larger doses of vitamin to protect them from loss in weight.

Preparation of the Crude Picrate

Having obtained a highly active vitamin extract, free of potassium salts, the next step was to prepare a picrate of it and determine what proportion of the total active material is present in the resulting compound. After many experiments the following procedure was adopted.

To the concentrated 66 per cent. alcoholic solution of the extract is slowly added, with stirring, an amount of picric acid, dissolved in warm methyl alcohol, approximately equal in weight to the solids pres-

ent in the extract. There is then added a volume of water equal to about one third that of the mixed alcoholic solution. This causes the separation of an additional amount of yellow precipitate. The mixture is then subjected to more or less rapid evaporation of the alcohol at a moderate temperature. Additional quantities of water are added to replace the alcohol from time to time, until no further clouding occurs on addition of the water. The yellow precipitate will then have assumed a more or less granular condition and can be conveniently removed by centrifugation. It should be washed by stirring once with about an equal volume of water and again centrifuging. The washed picrate, after pressing between filter paper and drying in a vacuum desiccator, will usually weigh somewhat more than the solids of the vitamin extract used for its preparation.

Activity of the Crude Picrate

In testing the picrates prepared in this manner, as well as the subsequent crops obtained by evaporating the liquid decanted from the first crop, the samples have been administered as such, without regard to what effect, if any, the picric acid contained in them might have on the pigeons. It was, therefore, necessary to test this point, and groups of pigeons fed on polished rice were given, respectively, (1) "activated solid," (2) "activated solid" plus large doses of picric acid and (3) Fuller's earth plus picric acid. The resulting changes in weight are exhibited

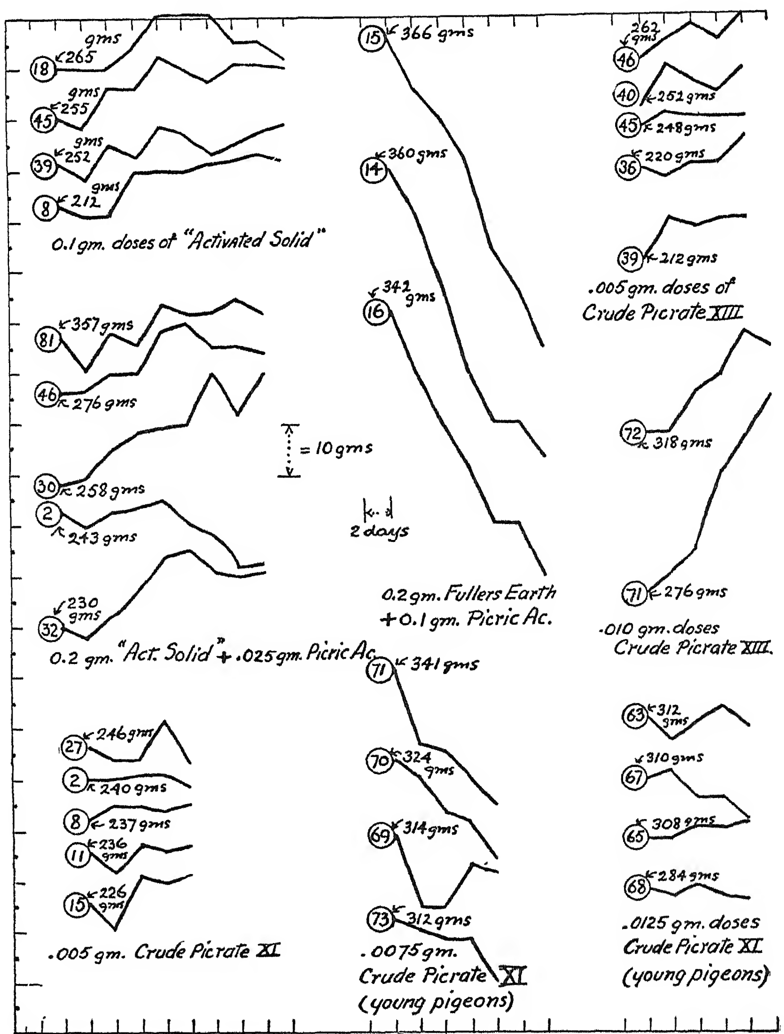

Chart 2.

This chart shows the changes in weight of pigeons fed on polished rice and given each second day the indicated quantities of various vitamin preparations. The figures in circles are the number, and the others the weight of the pigeons at the beginning of the test. Two of the above tests were made with pigeons one year or less in age.

in Chart II. There is also shown in this chart the weight curves of several groups of pigeons which were given doses of crude picrates prepared from vitamin extracts as described above.

It will be noted that the administration of picric acid in doses of 25 milligrams, which is four or more times the maximum quantity present in the largest doses of the active picrates, exerts no appreciable deleterious effect. A group of pigeons receiving picric acid without protective vitamin declined rapidly, thus serving as controls and showing that picric acid itself exerts absolutely no protection. Hence it is evident that in the case of picrates which prevent loss in weight on a rice diet, the activity must be due solely to the base united with the picric acid.

Attention should also be called to the variation in results obtained with young pigeons. Thus in the case of crude picrate XI, doses of 0.0125 gm were required to protect the young pigeons, whereas doses of 0.005 gm adequately protected the older ones.

The chart also shows that under the conditions of the test as here employed a period of eight days is sufficient for obtaining dependable information as to the activity of a given sample. It should be remembered, however, that in all feeding tests there are likely to be minor ill-defined factors which modify the results, and it is not always possible to obtain uniformly concordant figures for the activity of different preparations. Correct conclusions can be drawn only from an extended series of tests. In the present case a large number of experiments, made during many months, indicate that the crude picrate prepared as described protects pigeons of about one year in age from loss in weight on polished rice in doses of approximately 0.010 gm given on alternate days.

The solution separated from the above described picrate, when evaporated, yields further quantities of solid picrates, but these usually fail to protect pigeons in doses of two or three times the protective dose of the picrate which first separates. The solids of the final mother liquor also show a low protection. Approximately quantitative results indicate that about 80 per cent. of the vitamin originally present is retained by the first crop of crude picrate obtained as described.

Fractionation of the Crude Picrates

A superficial examination of the dried yellow granular picrate indicates that it is not homogeneous. Under the microscope there may be seen prismatic needles; bright reddish colored particles and numerous amorphous masses which may or may not show projecting spines. There is apparently more than one picrate present, and the relative amount of each probably depends upon the ratio of picric acid and concentration of alcohol present at the time the picrates separate from solution.

The product is only slightly soluble in water but dissolves readily in mixtures of acetone and water. It has been found that by digestion in acetone containing a small proportion of water the more active portion dissolves first. A separation of the active from the inactive constituents, by means of fractional solubility in 95 per cent. acetone, may be made as follows.

Ten grams of the crude picrate are stirred with 20 cc of 95 per cent. acetone until disintegration is complete and the mixture centrifuged. The supernatant acetone solution is decanted and the picrate stirred a second time, using 10 cc of acetone. The mixture is centrifuged and the second acetone extract decanted. This is repeated with 5 cc and 3 cc portions of 95 per cent. acetone. To the combined acetone extracts 20 cc of water are added and the liquid evaporated under diminished pressure. A yellow precipitate soon appears and increases in amount. Small quantities of water are added from time to time to replace the evaporated acetone. When the further addition of water fails to produce a clouding the yellow solid is filtered, pressed between filter paper and dried in a vacuum. The yield is usually about 5 grams. This procedure is then repeated on the once recrystallized acetone soluble picrate, using amounts of acetone, reduced in accordance with the weight of the once purified picrate available. There will now be obtained about 3.0 grams of twice crystallized acetone soluble picrate. This, as mentioned later, melts with decomposition at a temperature usually below 150°.

The acetone insoluble residue, when recrystallized from warm water or dilute acetone, yields well-formed prismatic needles which melt sharply at 202–3° and after complete dehydration at 206°. An investigation of the identity of this product is being made by Dr. W. O. Emery, of the Bureau of Chemistry.

Activity of the Acetone Soluble Picrate

Physiological tests of the fractions obtained by the above procedure were made on young pigeons of about one year in age. The results are given in Chart III. An examination of this chart shows clearly that the acetone insoluble part of the crude picrate possesses very little if any activity. Doses up to 20 milligrams did not prevent a rapid decline in weight, whereas doses of the acetone soluble fractions as low as 1 milligram exerted an appreciable effect. It is apparent that a fully protective dose of the acetone soluble fraction is about 4 milligrams, which is two and one half times less than the average quantity of the crude picrate required for protection.

Assuming a content of about 50 per cent. of picric

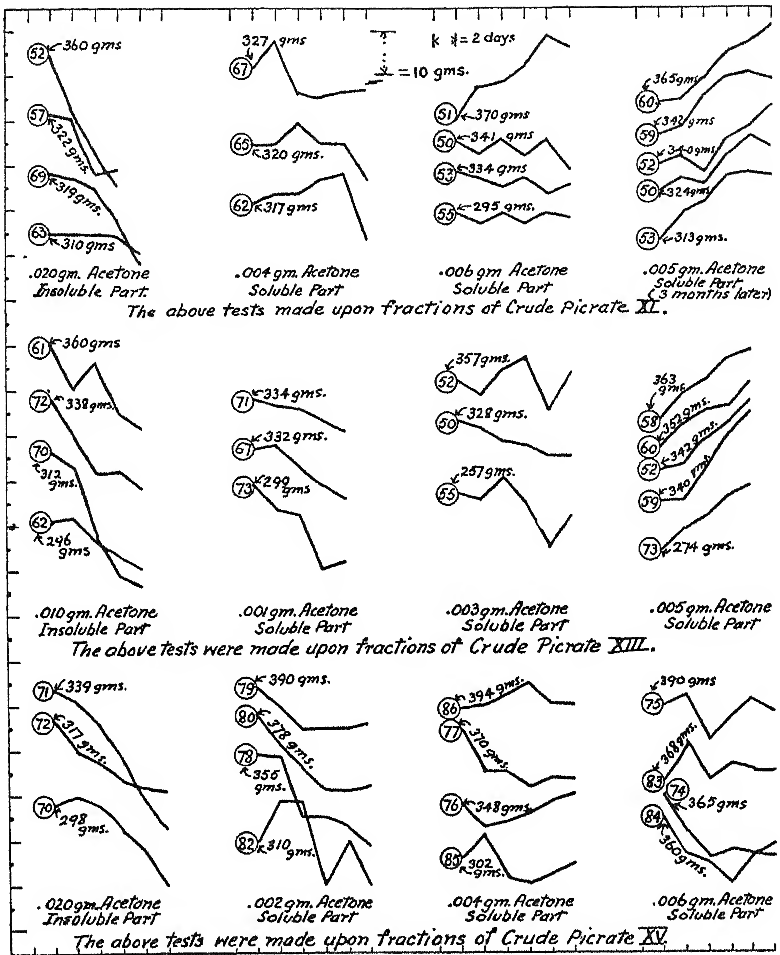

CHART 3.

This chart shows the changes in weight of pigeons of about one year in age fed on polished rice and given each second day the specified quantities of the 95% acetone soluble and insoluble fractions obtained from three samples of crude picrate. The figures in circles give the number, and the others the weight of the pigeon at the beginning of the test.

acid in the active fraction, the daily protective dose, calculated to uncombined vitamin base, would be approximately 1 milligram. For older pigeons probably less than one half this quantity would be sufficient. This is close to the previous figure calculated from nitrogen determination upon purified fractions obtained by the silver method[15] and shows that in both cases a distinctly significant amount of vitamin base is required for protection. It appears improbable, therefore, that the physiological action of vitamin is due to far smaller amounts of superactive substances of the nature of enzymes.

One other point worthy of note in connection with the present tests is that, in one case (see Chart III), a sample of the active fraction lost none of its protective power on being kept for a period of three months. It may, therefore, be concluded that the acetone purified picrate is a relatively stable form of antineuritic vitamin.

THE CHARACTER OF THE ACTIVE PICRATE

The first question which arises in connection with the acetone soluble picrate, obtained as described above, is whether its activity is to be ascribed to the one or probably more bases in combination with picric acid, or to some substance present as an impurity. An analysis of the process by which this final product is obtained indicates that the latter possibility is remote. If, for example, it is assumed that an unknown substance X is present, it will be necessary to ascribe to it exactly the same solubility relations exhibited by the acetone soluble picrate. Although it is possible that a compound, not a picrate, dissolves and sepa-

[15] Seidell, Public Health Reports, 37, 1523 (1922).

rates from solution in exactly the same manner as the picrate here described, it is not at all probable. As has been mentioned in connection with the fractionation process, another picrate (the sharply melting prismatic needles), no doubt closely related chemically to the active one, is almost, if not completely, separated from it by solubility differences in acetone. It would indeed be strange if some compound of an entirely different type should remain associated with only one of these two picrates, throughout the entire series of operations.

The possibility of such an attainment being due to an adsorption appears not to be well founded, since the solid picrate, on which it would be necessary to assume the adsorption occurs, separates from the same clear solution from which the hypothetical substance X is supposed to be subsequently adsorbed. Furthermore, the several crops of picrate which are successively obtained differ appreciably in activity and consequently, if the activity of the earlier crops is due to an adsorbed impurity, the latter crops should also obtain their share of it. The available evidence, therefore, points to the absence of adsorbed physiologically active impurities in the picrate obtained as described.

The question as to whether the recrystallized acetone soluble picrate is free from small amounts of a closely related picrate or degradation product of the active compound is still unsettled. The proper conditions for obtaining well-formed crystals have not been learned. The crystals that are obtained appear as aggregates of thin pale yellow plates with irregular outline. These show indices of refraction[16] of about 1.5 in the alpha direction and 1.8 + in the gamma. There is present, however, in all samples so far obtained a certain proportion of apparently potentially crystallizable material, which has not assumed a definitely crystalline character. This is probably due to the manner in which the crystallization occurs. As mentioned previously, water is added to the acetone solution of the picrate in repeated small quantities during the crystallization until its further addition causes no clouding. It has been found that this addition of water is essential, probably not to supply water of crystallization, since the final product has none, but to yield the proper dilution of acetone. As the solvent evaporates there first appears a yellow cloud which soon collects as a voluminous amorphous mass, throughout which, after a time, glistening facets can be distinguished. The volume gradually contracts and the crystalline appearance of the separated solid becomes more and more pronounced. There evidently takes place a gradual transition from the amorphous to crystalline state, and this process does not go to completion under the conditions which have so far been provided. Although this is to be regretted from the standpoint of accurate characterization of the product by its physical properties, it need not be a serious handicap to the identification of the compound. It is probably that the composition of the amorphous material is essentially the same as that of the crystalline portion, and analytical tests applied to samples containing the two forms should give trustworthy information concerning the identity of the active product.

[16] These estimates were made by Dr. E. T. Wherry, of the Bureau of Chemistry, to whom I wish to express my appreciation for his assistance.

Determinations of the melting point of the samples give unsatisfactory results since the product decomposes without melting sharply. The decomposition range varies somewhat with different samples but usually begins between 125° and 160° C. After an initial contraction, effervescence without discoloration occurs, and this increases slowly, accompanied by darkening, and ends in a greatly expanded mass of black foam.

The combustion analyses which have been made on the active picrate have not as yet given results from which it has been possible to calculate a satisfactory empirical formula. An approximate determination of amino nitrogen by the Van Slyke method indicated that a part of the nitrogen is present in this form. Tests of the rotatory power of the vitamin extract, before preparation of the picrate, showed an undoubted, although a very small, deviation to the left. Other qualitative tests for various properties and constituent groups have been applied, but an indication of the real identity of the compound has not as yet been obtained.

SUMMARY

There has been a notable revival of interest in the chemistry of vitamins within the past few years. The recent work has led to the isolation of more or less completely crystalline compounds having the properties ascribed to vitamins A, B and D. The evidence now available appears to definitely establish the conclusion that vitamins are not to be classed with enzymes. The physiologically active crystalline products which now for the first time have been isolated make possible intensive studies of the constitution and chemical properties of the several vitamins. Although many years have been required to obtain these elusive compounds in the state of purity now reported, it is probable that their identification will be accomplished in a much shorter time. With the completion of this latter phase of the problem we may confidently look forward to the eventual synthesis of the vitamins and their extensive application to the nutritive needs of man.

ATHERTON SEIDELL

HYGIENIC LABORATORY,
U. S. PUBLIC HEALTH SERVICE

WILLIAM MADDOCK BAYLISS—PHYSIOLOGIST

Biological science suffers a severe loss in the death on August 27, 1924, of Sir William Maddock Bayliss, recognized the world over as one of the foremost contemporary physiologists. The term "physiologist," as applied to him, has a very broad connotation, for, like Claude Bernard, whom he so greatly admired, he thought of physiology as nothing less than "the science of life." He had been for some years past professor of general physiology at University College, Gower Street, London, and as a research worker had performed many brilliant experiments. But he was more than a remarkable specialist, for he coupled with this a depth of general insight and a breadth of intellectual horizon which marked him as one of the biological philosophers of the age.

It was the publication of his "Principles of General Physiology" (1915) that brought Professor Bayliss most definitely and prominently before the scientific world. This book professedly dealt with "abstract physiology," and appearing at a time when problems of the war occupied the attention of scientific men its prompt and general recognition could not have been expected. However, even under these unfavorable circumstances, the volume, packed as it is with source materials, historical information and hints on technique and method, made a profound impression and was characterized as "Principia Physiologica." Bayliss Clubs were formed, at least in America, and there was a sense of having reached objectivity in the science of living substance.

"Principles," which reached its third edition in 1920, is a unique volume occupying a unique place. Most of the problems considered in it are common to man and to all living creatures, animal or plant. It is a masterly presentation of those physical and chemical processes which underlie the dynamic changes known as the phenomena of life. It is common to neglect reading those articles which do not appear to concern one's own particular domain of science. Just here is where the uniqueness of Professor Bayliss and his work show up sharply. He saw the need and took the trouble to work in many fields, often not biological, and here he uncovered materials of fundamental import to his subject. He arranged these facts in such a way as to produce a work that is of much use to all who have interest in science.

It need hardly be said that Professor Bayliss addressed himself to a very difficult subject when he chose to discuss the basic processes which intervene in vital phenomena. He had to blaze new trails and make tentative judgments on many very unsettled questions. The admirable way in which he has handled these problems must have appealed to all his readers. His point of view in reference to the frontier of science may be illustrated by a quotation from the remarkable preface of this book, which is so much an autobiography that it has to be given first consideration if one writes anything about its author. He says:

> Truth is more likely to come out of error, if this is clear and definite, than out of confusion, and my experience teaches me that it is better to hold a well-understood and intelligible opinion, even if it should turn out to be wrong, than to be content with a muddle-headed mixture of conflicting views, sometimes miscalled impartiality, and often no better than no opinion at all. . . . It is not going too far to say that the greatness of a scientific investigator does not rest on the fact of his having never made a mistake, but rather on his readiness to admit that he has done so, whenever the contrary evidence is cogent enough.

Sir William was born in 1860, the only son of an iron manufacturer of Wolverhampton, England. He was of short stature, did not have a rugged constitution and was rather reticent in his disposition. For a while he engaged in his father's business with a view to learning it, but was not happy there. Being later apprenticed to a physician, he found that work much more to his liking and entered University College, London, in 1881, apparently with the desire of pursuing medicine. He came under the tuition and influence of Burdon-Sanderson, then professor of physiology. The following year he obtained a university scholarship in zoology and continued his studies. Sanderson was called to Oxford in 1883. After some discouragements and disinclinations in reference to certain medical subjects Bayliss seems to have concluded to give up the notion of becoming a physician and to have decided to devote himself to physiology. He followed Sanderson to Oxford in 1885 and from there took his degree in 1888. Returning to London he established a private laboratory in his father's house at Hampstead Heath. Here he did a great deal of reading and considerable experimenting but apparently gave little thought to publishing reports of his work. He associated himself with Schafer who had succeeded Sanderson at University College and with whom he had studied after Sanderson went to Oxford. About this time E. H. Starling, who was instructor in physiology at Guy's Hospital, also began research work in Schafer's laboratory. Bayliss and Starling became very close friends and collaborators. This happy cooperation has continued through the years and bore abundant fruitage in the many papers along the well-known lines: electrical phenomena of the heart, the regulation of the circulation, the movements of the intestines, pancreatic secretion and the action of the hormones.

Bayliss married his colleague's sister, Gertrude E. Starling, in 1893.

When Schafer was called to Edinburgh and Starling was appointed to succeed him in 1899, Bayliss cast in his lot with his friend and brother in the department at University College. He became assistant, then assistant professor and finally professor of general physiology. Probably it was a very fortunate thing that Professor Bayliss was prevailed upon to enter the routine of teaching. Had he been allowed to continue in his own private laboratory, without any such demands shaping his interests, he doubtless would have made many important and critical experiments, but it is doubtful if "Principles" would ever have come from his pen. In 1910–11 during the illness of Professor Starling and again while he was engaged in war duties, 1915–19, Professor Bayliss acted as head of the department. For a time he was dean of the faculty of science. He was chairman of the Shock Committee of the Medical Research Council, a member of the Chemical Warfare Medical Committee and of the Research Committee of the Food Investigation Board. In 1903 he was elected fellow of the Royal Society and was a member of the council in 1913–15. He is well known as joint editor of *The Biochemical Journal* and just before his illness had assumed editorship of *Physiological Abstracts.*

Following the war, when men turned again to take up the threads of science for science sake, the recognition of Professor Bayliss came promptly. Among other honors received, the Copley Medal, which is the greatest distinction within the gift of the Royal Society, was bestowed on him in 1919, he was showered with honorary degrees and was knighted in 1922. Within the last few years he has published several books and monographs of note. The topics include: the nature of enzyme action, intravenous injection in wound-shock, the colloidal state in its medical and physiological aspects and the vaso-motor system, to name the more important. These volumes are based largely on research work carried out by himself and his colleagues. In all his writing there is exhibited a clearness of diction and a directness and fairness of judgment in reference to conflicting evidence on difficult problems that cause his books to be much sought in any library. He was the very embodiment of friendliness and cooperation. In his researches he concerned himself with what has been termed "the infinitely little" and in his personal relations he appreciated the untold value of "small things." His life and work exemplify the supreme effectiveness of that casual, quiet, simple and unassuming way of doing things that marked his manner.

STANFORD UNIVERSITY W. R. MILES

SCIENTIFIC EVENTS

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE tentative program for the coming annual meeting of the American Society of Mechanical Engineers, to be held in New York from December 1 to 4, has been announced. The first day of the meeting has been set aside for council meeting, local sections conferences and technical committee meetings. The technical sessions start Tuesday morning, December 2, and will last through Thursday afternoon. While the program is well balanced in that it touches on all phases of mechanical engineering, it is noteworthy in the fact that there are several sessions with papers of importance and value to members of the society who are interested in the engineering problems of the machine shop.

On Tuesday morning the session devoted to research in machine design and operation will furnish the opportunity for the presentation of various methods of measuring hardness. J. O. Keller, the author of the paper, spent the summer in a series of investigations in which he made hardness measurements by the various known methods, tensile tests, machineability tests and magnetic analyses of pieces of the same material subjected to different heat treatments. His results will include a report of measurements by the Herbert pendulum hardness tester which is a comparatively novel device in this country. At the same session a research committee on metal springs will present a progress report. Although this committee has been organized for a short time it has set up a program and is ready to seek financial support for its research.

At the general session on Tuesday morning R. Eksergian will present a mathematical analysis of strength and proportions of wheels, wheel centers and hubs. This paper will bring a large amount of data to the designing engineers.

On Tuesday afternoon there will be a session devoted to general machine-shop practice with papers on the effect of inaccuracies of gear teeth on mechanical springs, and on ruling line standards by the application of light interference. The paper on inaccuracies in gear teeth was prepared as a thesis at Leland Stanford University by L. J. Franklin and Charles Smith. J. K. Wood, who wrote the paper on mechanical springs, is chairman of the special research committee on this subject and in the paper he presents the results of long experience in designing springs and gives four new formulas for this purpose. The last paper at the session by C. G. Peters and H. B. Lewis is a joint production of the Brown & Sharpe Manufacturing Co. and the Bureau of Standards.

On Wednesday morning a collection of papers on the theory of lubrication will be presented. Lieutenant Commander L. N. Linsley, U. S. N., will present the results of an investigation of critical bearing pressures which he made while taking graduate work at Johns Hopkins University. H. A. S. Howarth's paper on lubrication is a supplement to the paper he presented at the 1923 annual meeting. Louis Illmer's contribution on high-pressure bearing research completes the session.

As the early work in the development of management science was a product of the machine-shop under the leadership of Dr. Taylor, machine-shop men will undoubtedly be interested in Frederick W. Taylor's paper on shop management originally given to the society in 1903 and now presented again by Morris L. Cooke for further discussion. This will take place on Thursday morning, December 4.

On Thursday afternoon there will be two papers which treat of different phases of production control. George D. Babcock will state principles of production control which he has applied to the manufacture of tractors. Ralph E. Flanders will deal with the design, manufacture and production control of a standard machine. In his work Mr. Flanders has been dealing with the problem of reducing manufacturing overhead expense under conditions of fluctuating rates of production.

An innovation at the coming annual meeting is the insertion of two lectures, one on Tuesday afternoon at 4:30 and one on Thursday afternoon at 4:30. The Tuesday lecture will deal with an economic question of interest to engineers and the Thursday lecture will be an interesting presentation of scientific research also of interest to the engineering profession. The time for these two lectures has been set for 4:30 to permit all the members who have been attending the sessions previous to these lectures to be present.

MEETING OF THE METRIC ASSOCIATION

The Metric Association will hold its annual meeting in Washington, D. C., on December 29 and 30. A program of special interest to manufacturers, merchants and educators is being arranged. George F. Kunz, president of the Metric Association, will preside. Among others scheduled to speak are Arthur E. Kennelly and Alexander McAdie, of Cambridge, Mass.; Theodore H. Miller, F. L. Roberts and Howard Richards, of New York; Charles L. Parsons, S. J. Macfarren and G. H. Paine, of the Columbia Section of the Metric Association, and representatives of the government departments interested. Experts in several industries are to hold conferences in connection with the meeting.

An educational exhibit will be on display during the meeting and also throughout the meeting of the American Association for the Advancement of Science. Modern methods of teaching metric weights and measures will be demonstrated and the educational booklets, rulers and other devices will be considered.

A "weights and measures" luncheon will be held on Monday, the twenty-ninth, at 1 P. M., at the New Willard Hotel. The convention will close with a metric dinner at the New Willard Hotel on Tuesday evening, December 30. Men and women are invited to take part in the entire program. Federal, state and municipal departments and all organizations interested in international standardization are requested to send representatives. Programs, metric literature, etc., may be secured from the Metric Association, New York City.

Howard Richards, *Secretary*

ACTIVITIES OF THE ILLINOIS GEOLOGICAL SURVEY

The Illinois Geological Survey has continued its usual investigations during the past summer, bearing on the occurrence of oil, the correlation and resources of its coal beds, systemic stratigraphy, geologic quadrangle mapping, and the paleobotany of the "coal measures," and in addition cooperated with the United States Geological Survey in an extensive topographic mapping program.

Some of the new features of the Illinois Geological Survey's program have included: (1) the detailed stratigraphy of the Silurian of northern Illinois by Professor T. E. Savage, of the University of Illinois; (2) the chemical study of the oil field waters of the state under the direction of Mr. Gail F. Moulton, formerly assistant professor of geology at the University of South Dakota and associate geologist of the U. S. Geological Survey; (3) laboratory sedimentation studies of the Chester series by Mr. J. E. Lamar, who has made a field study of the series and collected systematically a set of some 2,000 specimens; and (4) a field and laboratory investigation of the state's molding sand resources by Mr. Max Littlefield of the University of Iowa in cooperation with the foundry laboratory of the Engineering Experiment Station of the University of Illinois.

The generous appropriation of the last legislature for topographic mapping amounting to $100,000 for the biennium, with an equal allotment from the Federal Survey, has greatly stimulated the mapping program, and it is anticipated that by the close of the biennium next June 30, some 4,500 square miles of additional territory will have been sketched, including the revision of the maps of Chicago and vicinity.

LECTURES BY INDUSTRIAL FELLOWS OF MELLON INSTITUTE

THE following course of lectures by specialists engaged in research in the Mellon Institute of Industrial Research of the University of Pittsburgh will be given throughout the first and second semesters of the university year 1924–1925, on Monday afternoons at 4:30, in the Fellows' Room of the institute. Each discourse will be one hour in length and will deal with raw materials, manufacturing processes, properties and uses of the techno-chemical products scheduled for discussion.

The lectures are open to the membership of the institute, to interested faculty members and qualified students of the University of Pittsburgh, and to teachers of chemistry and chemists in the Pittsburgh district.

October 6, Insecticides and fungicides, Dr. O. F. Hedenburg.
October 13, Matches, Dr. E. E. Marbaker.
October 20, Fertilizers, Mr. H. H. Myers.
October 27, Portland cement, Mr. Tracy Bartholomew.
November 3, Metallurgical refractories, Mr. M. C. Booze.
November 10, Heat-insulation materials, Mr. R. H. Heilman.
November 17, Corrosion preventives, Mr. C. R. Texter.
November 24, Wrought iron, Dr. B. B. Wescott.
December 1, Protected metals, Dr. J. H. Young.
December 8, Enameled cast iron and sheet steel, Mr. J. E. Hansen.
December 15, Galvanized metal ware, Mr. W. G. Imhoff.
January 5, Salt, Mr. C. C. Kesler.
January 12, Inks, Dr. F. F. Rupert.
January 19, Wood preservatives, Dr. A. M. Howald.
January 26, Petroleum products, Dr. W. A. Gruse.
February 2, Wood chemicals, Mr. R. F. Remler.
February 16, By-product coke, Mr. O. O. Malleis.
February 23, Rubber, Mr. H. W. Greider.
March 2, Cotton textiles, Mr. E. R. Clark.
March 9, Cellulose esters, Dr. W. F. Henderson.
March 16, Sugar, Dr. D. K. Tressler.
March 23, High explosives, Dr. H. L. Cox.
March 30, Edible gelatin, Dr. T. B. Downey.
April 6, Cereal products, Dr. H. A. Kohman.
April 13, Packed foods, Mr. E. R. Harding.
April 20, Official drugs, Dr. A. W. Harvey.
April 27, Newer medicinal agents, Dr. L. H. Cratcher.
May 4, Perfumes, Dr. E. H. Balz.

SCIENTIFIC NOTES AND NEWS

THE French Institute has awarded triennial Osiris prizes of the value of 100,000 francs to Dr. Charles Fabry, for the invention of his interferometer and to M. Jean Richepin, the poet. Dr. Fabry, professor of physics at the University of Paris, is now lecturing at the Massachusetts Institute of Technology.

PROFESSOR E. C. KENDALL, who is in charge of the chemical division of the Mayo Foundation of the University of Minnesota, has been appointed the Chandler lecturer, and will receive the Chandler Medal at a meeting to be held next February.

THE Royal Institute of Scientific Industrial Research of Sweden has awarded its gold medal of the first class to Johannes Ruths, for his invention of the Ruths steam accumulator. This is the first time the medal has been awarded.

THE twenty-fifth anniversary of Professor G. Jelgersma's incumbency of the chair of nervous and mental diseases at the University of Leyden was celebrated by the presentation of his portrait and addresses by twelve speakers representing the universities and medical societies of the Netherlands.

PROFESSOR EDOUARD BRANLY, the French pioneer of radio-telegraphy, celebrated his eightieth birthday on October 22.

DR. JOANNIS, professor of chemistry at the University of Paris, recently retired.

STEPHEN MOULTON BABCOCK, inventor of the "Babcock Test" for determining the amount of butter fat contained in milk, and formerly professor of agricultural chemistry at the University of Wisconsin, recently celebrated his eighty-first birthday.

CLINTON N. LAIRD, professor of chemistry at Canton Christian College, Canton, China, is spending a year, while on leave of absence, at the School of Hygiene and Public Health of the Johns Hopkins University.

GALO W. BLANCO has left his position as chief research chemist for the Riordan Pulp Corporation, Ontario, to take charge of Research on Viscose at the DuPont Fibresilk Company, Buffalo, N. Y.

LAURA I. MCLAUGHLIN, of the University of Chicago, has joined the staff of the bureau of home economics of the United States Department of Agriculture as nutrition chemist.

ROY A. LEWIS, general manager of the Bethlehem Steel Company, Bethlehem, Pa., has joined the staff of lecturers at Lehigh University. Winthrop O. Hearsey, superintendent of the service department of the same company, has also become a member of the staff of lecturers.

PROFESSOR HOWARD ECKER, head of the department of chemistry at the Ohio Mechanics Institute, is now in charge of research for the Johnston Paint Co., Cincinnati, Ohio.

DR. JOHN ALBERT KEY has left Baltimore to take

charge of research work at the Shriner Hospital for Crippled Children, St. Louis.

DURING the past season the members of the staff of the Roosevelt Wild Life Forest Experiment Station of the New York State College of Forestry at Syracuse have been engaged in field studies as follows: Dr. Charles E. Johnson continued his study of the Adirondack beaver, Dr. A. O. Gross has studied the status of the ruffed grouse in the lower Hudson Valley and Mr. B. A. Scudder has studied the Adirondack deer situation.

DR. PRESTON E. JAMES, assistant professor of geography at the University of Michigan, recently returned from field studies in Trinidad, British West Indies.

PROFESSOR J. HOWARD ALLISON has returned to his work at the University of Minnesota after a year studying forestry in Sweden, as a fellow of the American-Scandinavian Foundation.

DAVID J. PRICE is on leave of absence for several months from the division of development work of the U. S. Bureau of Chemistry, to carry out some special engineering studies at the Pennsylvania State College.

DEAN C. E. SEASHORE, of the University of Iowa, is spending six weeks beginning on November 1 in visiting colleges and universities in the west for conferences with faculties in the interest of the gifted student project of the Division of Educational Relations in the National Research Council.

PROFESSOR RALPH H. MCKEE, of Columbia University, left on November 1 for Italy, Poland and France. He will return the latter part of December.

DR. S. O. FLADNESS, of the U. S. Bureau of Animal Industry, has left for Mexico City, where he will take up his work as agricultural commissioner from the United States on November 1. He will cooperate with Mexican agricultural experts in putting the agricultural relations of the two countries on a sound economic basis, and will represent the U. S. Department of Agriculture in all matters involving the interests of the United States.

DR. CHARLES C. ADAMS, director of the Roosevelt Wild Life Forest Experiment Station of the New York State College of Forestry at Syracuse, spent July, August and September in visiting the national forests and national parks of the southwest. Special attention was given to wild-life problems and the policies of the national parks and the national forests.

DR. A. V. HILL, professor of physiology at University College, London, will deliver the third Harvey Society Lecture at the New York Academy of Medicine, on Saturday evening, November 15. His subject will be "The recovery process after muscular exercise in man."

PROFESSOR CHARLES DE LA VALLÉE-POUSSIN, of the department of mathematics of the University of Louvain, Belgium, recently delivered two lectures at the University of Michigan.

DR. I. M. KOLTHOFF, of the University of Utrecht, Holland, who is visiting the United States under the auspices of the University of Michigan, lectured at the university on October 16 on "The use of different electrodes in neutralization reactions."

DR. EDWARD F. ARMSTRONG, president of the Society of Chemical Industry in England, spoke at Yale University on the "Basis of development in chemistry" on October 23.

COURSES on human phylogeny and on ontogeny are being given in the United States National Museum by Dr. Aleš Hrdlička, on Monday and Friday afternoons.

E. F. BURCHARD, of the U. S. Geological Survey, recently addressed The Bag and Hammer, a geological society with a membership recruited from the department of geology at the University of Cincinnati. The subject of the lecture was "The geology of the Birmingham, Alabama, iron district."

J. E. SPURR, editor-in-chief of the *Engineering and Mining Journal-Press*, New York, delivered three lectures on ore deposits, at the University of Toronto, on October 29 and 30. These lectures were given under the auspices of the department of geology of the university, two of them being class lectures and the other an evening lecture on "Ore magmas" which was attended by members of the Toronto branch of the Canadian Institute of Mining and Metallurgy.

THE Henry Ward Beecher lectures at Amherst College will be given by Professor James H. Breasted, director of the oriental institute at the University of Chicago. The series will consist of four lectures, to be given on November 17, 18, 19 and 20.

AT a joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington, held at the Cosmos Club, Washington, on November 1, Professor H. N. Russell, of Princeton University, delivered an address on "Recent advances in our knowledge of the interior of the stars."

THE inaugural address of the president of the Association of Economic Biologists was delivered on October 24, by Dr. F. A. E. Crew, director of the Animal Research Station, Edinburgh, at the Imperial College of Science and Technology, England.

THE General Electric Company has appropriated $25,000 for a memorial fund for Union College in memory of Dr. Charles P. Steinmetz, the company's chief consulting engineer, who died a year ago. The income from this fund will be used to provide four annual scholarships.

The contract has been let for the erection of a statue in Georgia to Dr. Crawford W. Long, whose name is important in the history of anesthesia. The statue of marble, costing about $9,000, will be completed not later than December 1, 1925.

A tablet was unveiled on October 5 by the Paris Academy of Sciences in commemoration of the mathematician, Charles Hermite, at Dieuze, his birthplace.

Dr. Morris B. Miller, emeritus professor of surgery in the graduate school of medicine of the University of Pennsylvania, died on November 5, at the age of fifty-seven years.

Dr. Robert Peel Leslie, Ph.D. (Toronto), of New York City, well-known pharmacist and head of Leslie & Co., Inc., died on October 31, at the age of forty-seven years.

Dr. Edouard G. Deville, director-general of surveys in the Canadian Department of the Interior, and author of "Astronomic and geodetic calculations" and "Photographic surveying," died on September 21, aged seventy-three years.

Dr. Santiago Roth, head of the department of paleontology in the Museo de La Plate, Argentina, died on August 4.

Dr. E. O. Fenzi, of Italy, the well-known horticulturist and introducer of the alligator pear into California, died on November 6 in his eighty-first year.

Dr. G. Pruvot, professor of zoology and comparative physiology at the University of Paris and formerly director of the Marine Zoological Laboratories at Banyuls-sur-Mer, has died.

Lady Teall has presented to the Sedgwick Museum, of the University of Cambridge, the collection of rocks and rock-slices made by her late husband, Sir Jethro Teall, Sc.D., St. John's College. The collection contains numerous slices described and figured by Sir Jethro in his work, "British Petrography," and in a number of his published papers.

Negotiations are expected to be completed shortly whereby the garret in Heathfield Hall, Handsworth, in which James Watt conducted the experiments which led to the development of the steam engine, will be brought bodily to London to be perpetuated in the South Kensington Museum. Watt first went to Heathfield Hall in 1768. After his death the room in which he worked remained locked for many years, and his tools and benches have been undisturbed.

Acting Secretary Howard M. Gore, of the U. S. Department of Agriculture, announces that the conference on utilization of forest products called by the late Secretary Wallace for November 19 and 20 will not be postponed. Secretary Wallace regarded waste reduction as one of the most important phases of forest conservation and expected much to be accomplished by the forthcoming conference. The department will commemorate his great service to forestry by carrying out the conference as he planned.

At the annual meeting of the American Public Health Association, held in Detroit from October 20 to 23, the following officers were elected: *President,* Henry F. Vaughan, Detroit; *vice-presidents,* Drs. Oscar Dowling, New Orleans; Daniel A. McClenahan, Hamilton, Canada, and Powhatan S. Schenck, Norfolk, Va.; *treasurer,* Louis I. Dublin, New York, and *secretary,* Mr. Homer N. Calver, New York.

The Institution of Electrical Engineers held its first meeting of the 1924–25 session on October 23, when the retiring president announced that the council had made a gift of 100 guineas to the Cavendish Laboratory, Cambridge, as an appreciation of the work done there by distinguished physicists. Dr. A. Russell presented the awards made by the council for papers read during the previous session. W. B. Woodhouse, the new president, then took the chair, and called on Ll. B. Atkinson to propose a vote of thanks to the retiring president, which was seconded by J. S. Highfield, and passed with acclamation, Dr. Russell replying.

The following lectures are being given at the New York Botanical Garden on Saturday afternoons at 3 P. M.: November 1, "The rock garden," Dr. E. B. Southwick; November 8, "The hardy chrysanthemums," Mr. K. R. Boynton; November 15, "The hemlock grove," Dr. H. A. Gleason; November 22, "The pinetum—The collection of evergreen trees," Dr. N. L. Britton; November 29, "The geology of the New York Botanical Garden," Dr. Arthur Hollick.

The following public lectures have been given this fall at the Brooklyn Botanic Garden: September 21, "Asters and other herbaceous perennials," H. E. Downer, horticulturist, Vassar College; September 28, "Waterlilies," Charles L. Tricker, horticulturist; October 5, "Cannas," Louis Wintzer, of the Conard and Jones Co.; November 3, "The effect of electricity on the growth of plants," Dr. V. H. Blackman, professor of plant physiology and pathology, Imperial College of Science and Technology, London.

At the October meetings of the Astronomy and Physics Club of Pasadena the programs were as follows: October 3, "Relativity," Professor A. S. Eddington; October 10, "Is the Compton effect a real effect?" Professor E. C. Watson; October 17, "Modern dynamics," Professor Geo. D. Birkhoff; October 24, "The constancy of the total photoelectric effect in sodium with temperature," R. C. Burt; October 31, "Planetary radiation," Dr. S. B. Nicholson.

The National Museum of Wales at Cardiff has received from Sir William Reardon and Lady Smith a further sum of £5,000, bringing their total contribution to £15,000.

The American Society for Clinical Investigation has founded a journal to be called the *Journal of Clinical Investigation,* and Dr. G. Canby Robinson, dean-elect and professor of medicine at Vanderbilt University, will be editor-in-chief. The new journal has been made possible by a grant to the society by the Rockefeller Institute for Medical Research. The first issue appeared in October.

UNIVERSITY AND EDUCATIONAL NOTES

Harvard College is the beneficiary of one half the estate of George True Nealley, of New York, and the National Academy of Sciences and the National Geographic Society divide the other half equally. The value of his estate was not made known.

It is announced that the University of Pittsburgh has completed plans for the erection of a fifty-two story building, 680 feet high, to be the center of the university activities.

A new group of four buildings at Western University, London, Ontario, which has cost £300,000, were formally opened on October 23.

A celebration commemorative of the centennial of the foundation of the Medical College of the State of South Carolina took place at Charleston on November 12 and 13.

The statutes of the University of London have been amended to allow the university to confer the degree of bachelor of pharmacy.

Dr. L. W. Taylor, of the University of Chicago, has been appointed head of the department of physics at Oberlin College, to take the place of Professor S. R. Williams, who has resigned.

Wilfred Eldred, associate in the food research institute of Stanford University, has been appointed to a research professorship in the University of Washington.

Dr. Harold St. John, of the department of botany at the State College of Washington, has been promoted to be associate professor of botany and curator of the herbarium.

Dr. Glenn E. Cullen, associate professor of research medicine at the University of Pennsylvania, has been appointed professor of biochemistry in the medical school of Vanderbilt University. Dr. Cullen will be in Europe for a year at Rigs Hospital, Copenhagen.

Dr. Thomas Grover Orr, a physician of Kansas City, has been appointed head of the surgical department of the school of medicine at the University of Kansas.

Dr. Basil Graves, curator of the Royal Westminster Ophthalmic Hospital, has been appointed clinical lecturer and special instructor in charge of the department for microscopy of the living eye in the department of ophthalmology of the graduate school of medicine at the University of Pennsylvania, for a period of three months from January 1, 1925.

Dr. A. T. de Mouilpied, of the British Dyestuffs Corporation, has been appointed professor of science at the Royal Military Academy, Woolwich, in succession to Professor J. Young.

Dr. Alfred Kuhn, professor of zoology at the University of Göttingen, has declined the offer of the professorship of zoology and comparative anatomy at Munich.

DISCUSSION AND CORRESPONDENCE

THERMOMETER SCALES

Apropos of the discussion on thermometer scales it may be worth while to consider some points generally ignored. As far as the people at large are concerned practically everybody is familiar with the relations between the Fahrenheit scale and the temperatures, and it would be most difficult and confusing to them to make a change.

But apart from that, the ideal thermometric scale is far from the centigrade type, at least for those having to do with meteorological statistics. The centigrade is extremely defective in that its degrees are so large that exact work requires decimal fractions to be tabulated, and it has an arbitrary zero requiring plus and minus signs to indicate degrees of temperature. One reason why the Fahrenheit scale is better is that its degrees are so much smaller.

The ideal thermometer will have its scale running all one way, eliminating plus and minus signs, and its degree divisions small enough to require at most only one decimal point in tabulating fractions. The only instance I have come across in which these points are recognized is the scale invented by Louis De Lisle de la Croyère about the end of the 18th century, probably described in the Journal of the Hydrographic Department of the Russian navy, vol. VII, pp. 537–542, 1849 (which I have not seen), and used in the appendix to Krashenninikoff's "History of

Kamchatka" in 1768, or earlier, since this issue is not the first of that work. If we are to have a change of scale let it be to something less objectionable than the centigrade form.

Wm. H. Dall

NOTE ON CELLOBIOS AS A DIFFERENTIATING SUGAR FOR CERTAIN BACTERIA

Through the kindness of Dr. Wise, of the New York State College of Forestry, the writer was recently enabled to test the fermentative powers of a number of strains of bacteria of the colon-aerogenes group on the rare sugar known as cellobios. This disaccharide is derived by the acetolysis of cellulose (which yields the octacetate) followed by the removal of the acetyl groups.

The studies so far made indicate that this sugar may be of definite assistance in differentiating members of the genera Escherichia and Aerobacter. Particularly interesting is the fact that certain strains of *Escherichia neapolitana* can be separated into two groups by the use of this sugar; one group fermenting it with very abundant gas production and the other failing to act on it at all.

Further studies on the use of this sugar in bacteriological work are in progress, and bacteriologists having stock cultures of the colon-aerogenes group are invited to submit them for tests with the sugar.

Although this sugar has heretofore seldom been prepared in any considerable amounts, and is not now available in the market, should the demand arise it could doubtless be supplied by certain concerns, since the raw material from which it is prepared (cotton cellulose) is cheap and abundant.

Henry N. Jones
Syracuse University

COLOR INDICATORS FOR BLIGHT DISINFECTANTS

One of the serious practical difficulties involved in control of fire blight (due to *B. amylovorus*) in the orchard lies in securing thorough prophylactic treatment of the lesions after removal or scarification of diseased tissue. This difficulty is, of course, intensified when the treatment must be in the hands of untrained fruit-growers or hired help. Even when the affected tissues are completely removed the sterilization of the remaining exposed tissues is frequently careless and defective. Consequently, any device that will aid in securing thoroughness in this step can not but help make the whole treatment more effective.

Careful check on the thoroughness of the application of the mercury solution is difficult because of its lack of color. The writer has tried several coloring materials and at the suggestion of Professor Patton, Experiment Station chemist, fuchsin red and methylene blue were used. Fuchsin red has proved particularly satisfactory. Added to the Reimer-Day mercury and glycerine solution it has imparted a pronounced color, permitting the operator to detect any small untreated surface and to tell at a glance whether all the cut tissues in the tree have been treated. Field observation has not indicated any diminution in the effectiveness of the material, and the treatment because of the greater thoroughness becomes more effective.

In addition, because the operator is not forced to retrace his steps to make sure that a given wound has been sterilized, time and material is saved.

It should be noted that no laboratory tests of this material with the dye added are available at present, and this communication is based on field observation.

H. A. Cardinell
Michigan Agricultural College

ARIZONA RUINS

In the course of a recent prospecting trip in the neighborhood of Clifton, Arizona, I had the opportunity to visit some prehistoric ruins. These consisted of, apparently, dwellings and storehouses built under overhanging cliffs. The storehouses were formed of three adobe walls reinforced with wickerwork. The fourth wall at the back was the natural face of the cliff. Slight excavations disclosed the small Indian corn-cob and several types of seed-pods unknown to me. Excavations on the dwelling platform in front of the storehouses, which were some six feet square, disclosed pot shards, remains of grass sandals and some fragments of basketry. The walls of the cliffs outside of the smoked surfaces showed a number of disconnected outline paintings. These were in red or green and in some instances combinations of the two colors. I suspect that the green pigment was some copper mineral pulverized but had no facilities for analysis. Subjects were varied. They included geometrical designs, men, mountain goats, centipedes and fish. They ranged from a foot to two feet in length and the same in height. I made sketches in pencil of many of them of which I would gladly send copies to any person interested as well as any further details desired. Messrs. Thompson and Lenard, the owners of the Spur Cross ranch on which the caves are located, assure me that there are other caves in the vicinity which were not visited because of lack of time and further that no archeologist has ever visited the district. It seems to me worthy of exploration.

R. S. Everit
Barre, Mass.

SPECIAL ARTICLES

THERMAL EXPANSION OF WOOD

Up to the present time very little work has been done on the thermal expansion of wood. Villari[1] made measurements on several varieties in 1868, and Glatzel[2] worked on the longitudinal expansion in 1877. Glatzel dried his specimens in a vacuum at room temperature. His results show a continuous change in coefficients of expansion for consecutive heating and cooling. There was also as high as 35 per cent. difference between the coefficients determined from the heating and cooling changes, the cooling giving the greater coefficient. This would seem to indicate that the specimen was not completely dried and was losing moisture. Villari worked on wood which had been prepared by soaking in oil at 120° to 140° for 48 hours. This is a rather unusual treatment for wood, and it seemed of interest to find what its coefficient of expansion would be under other conditions.

Oven-dried Wood

In the present investigation the expansion was first determined for oven-dried specimens. The change in length was measured by means of two micrometer microscopes rigidly mounted and placed in front of a Freas electric oven with automatic temperature control. Coefficients were determined for both expansion and contraction and the constancy of the two coefficients was used as a check on the constancy of the moisture content. It is very important that the moisture content remain constant as a small change in this will mask the expansion due to change in temperature, especially when working with cross-section expansions.

Changes in temperature were determined by means of a standardized mercury thermometer placed directly over and almost in contact with the specimen under investigation. Any changes in the temperature of the mounting of the microscopes was observed and a correction made for this change.

The inner glass door of the oven was kept closed during a test and all the observations were taken through the door so that there would be no change in the thermal conditions.

Work on Wood Containing Moisture

Determinations were also taken on wood at room-dry conditions. It was found impossible to maintain the moisture content constant for room-dry specimens and so it was decided to determine the coefficient as the specimen was drying and then correct for the drying loss.

The rate of drying increases with the temperature while the rate of increase in temperature for a given run of the experiment decreases as the temperature nears the maximum. From a consideration of the first of these facts, it would appear that the average rate of drying would give too large a correction for the drying loss; but from the second fact it is seen that the specimen was above the average temperature for more than half the time which would tend to increase the loss and to a partial degree compensate for the other. Thus in making the correction the average rate of drying was used and it was considered that by so doing the error introduced was smaller than the other experimental errors of the determination.

Work on Oil-soaked Wood

White pine was also tested under conditions similar to those under which Villari tested his specimens. For this purpose the specimens were placed in hot neatsfoot oil at about 120° C. for 48 hours and then taken out and tested in the same manner that the dry specimens had been tested. It was found that under these conditions the results agreed to within from 1 to 8 per cent. with those of Villari.

Results for temperature range 20° to 50° C.

Wood	Condition	Coef. of expan. per ° C. x 10^4 Right angles to grain	Coef. of expan. per ° C. x 10^4 Parallel to grain
White pine (Pinus Strobus)	dry	.636	.0365
	4% moisture	.727	
	5% moisture		.0400
	oil-soaked	.346	.0511
Basswood (Tilia Americana)	dry	.444	.0546
Tulip poplar (Liriodendron Tulipifera)	dry	.429	.0595
Hard maple (Acer Saccharum)	dry	.602	.0422
White ash (Fraxinus Americana)	dry	.458	.1100

The varieties of wood tested have been verified by Dr. Brown, of the New York State College of Forestry.

The results here given are of a preliminary nature and it is expected to extend the work to cover more

[1] E. Villari, *Annalen der Physik,* 133, p. 400, 1868.

[2] P. Glatzel, *Annalen der Physik,* 160, p. 497, 1877.

varieties of wood and wood under various conditions.

Otis P. Hendershot
Steele Hall of Physics,
Syracuse University,
Syracuse, N. Y., June, 1924.

THE EFFECT OF MINERAL SUPPLEMENTS ON GROWTH AND REPRODUCTION

The effect of adding various mineral supplements to a basal ration of 2 parts of yellow corn and 1 part of peanut meal was tested on albino rats. The basal ration is often used for the feeding of swine in the south.

The plan of feeding was as follows:

Lot 1—Basal ration alone		
Lot 2—Basal ration	99	per cent.
NaCl	1	per cent.
Lot 3—Basal ration	97.5	per cent.
NaCl	1.0	per cent.
$CaCO_3$	1.5	per cent.
Lot 4—Basal ration	97.5	per cent.
NaCl	1.0	per cent.
Steamed bone meal	1.5	per cent.
Lot 5—Basal ration	97.5	per cent.
NaCl	1.0	per cent.
Acid phosphate	1.5	per cent.

Effect on Growth

Lot 1 made very little growth. Lot 2 made gradual gains for a period of two to three months. This was followed by a decline in the weights of the males and approximate maintenance in the weights of the females.

The rate of growth in Lots 3, 4 and 5 was normal and was practically the same in all three lots during the first weeks of the experiment. The rats that received steamed bone meal, however, sustained their growth longer and reached a greater final weight on the average than those that received the $CaCO_3$ or the acid phosphate. The curves for the latter two lots were very similar.

Effect on Reproduction

The differences in reproduction were more striking than the differences in growth.

None of the females in Lots 1 and 2 showed signs of pregnancy.

In Lot 3 rearing of young was successful in the first litters of the second generation. Later litters did not grow so rapidly. The third generation was a failure.

Young were successfully raised in the fourth generation in Lot 4. The results in the third and fourth generations were not normal but were decidedly superior to those in any of the other groups.

Reproduction in Lot 5 was most disappointing in view of the fact that this group made about as good growth in the first generation as Lot 3. The females in Lot 5 littered fairly regularly, but the young were small, low in vitality and usually died within a few hours after birth.

Growth curves and analyses showing the ash content of the bodies of rats from each lot will be published later.

W. D. Salmon
Alabama Experiment Station

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE FALL MEETING OF THE EXECUTIVE COMMITTEE

The regular fall meeting of the executive committee of the council of the American Association was held at the Cosmos Club in Washington, on Sunday, October 12, with the following members present: Cattell, Humphreys, Livingston, Osborn, Ward. The following members were absent: Fairchild, Flexner, MacDougal, Miller, W. A. Noyes. In the absence of the chairman, the president of the association was elected chairman for the meeting. Three sessions were held, one in the forenoon, one in the afternoon and the third in the evening. A vote by mail has been taken among the absentee members on the items of business transacted at the meeting, this having been needed on account of the presence of only five members, six being required for a majority of the committee. The following items of business were transacted and have received the approval of more than a majority.

1. The election of Dr. F. G. Cottrell as chairman of Section C (Chemistry) was approved.

2. The permanent secretary's annual report on the affairs of the association was accepted. It will appear in Science in the near future.

3. The permanent secretary's annual financial report was accepted and ordered audited and then presented to the council.

4. The annual report of the assistant treasurer was accepted and ordered audited and then presented to the council.

5. It was voted that any funds appropriated for grants which shall not have been disbursed at the end of the fiscal year for which they were appropriated shall revert to the treasury as appropriable funds on October 1. It is, however, understood that this rule does not prejudice the possible transfer of any unused grant or any unused portion of a grant to the next fiscal year, providing this transfer be recommended by the Committee on Grants.

6. Six members were elected to fellowship.

7. It was recommended to the council that a fund of $3,000 be appropriated from the treasury for new allotments by the Committee on Grants for the fiscal year 1924–25.

8. It was recommended to the council that three emeritus life memberships on the Jane M. Smith Fund be established this year.

9. It was recommended to the council that a grant of $200 be made from the treasury funds for the Annual Tables of Physical and Chemical Constants for the year 1925.

10. The committee expressed its hearty appreciation of the excellent services given to the association by the executive assistant, Mr. Sam Woodley, who has charge of the regular business of the Washington office.

11. The permanent secretary was instructed to arrange for a classification of the several lines of activity of Section L (Historical and Philological Sciences) under two or three subsections, as may be desired by the special committees involved, a plan to be worked out for the alternation of the subsections in the organization of the section as a whole. The chairman of the Committee on Linguistic Sciences is to be chairman of the section committee for next year.

12. It was voted that entrance fees be regularly omitted in the following cases of persons who may join the association, according to the rule for new members of affiliated societies: (1) members of the local committee and its sub-committees for any meeting; (2) local representatives of sections for any meeting and (3) members of section committees.

13. The following fellows were named as occupants of the American Association table at the Naples Zoological Station for the periods shown:

Dr. Otto Glaser, February 1 to April 15, 1925.

Dr. A. R. Moore, April 15 to June 30, 1925.

14. Places for future meetings of the association were considered, but no action was taken. Future meetings thus far scheduled are as follows: Washington, December, 1924; Kansas City, December, 1925; Philadelphia, December, 1926; New York, December, 1928. The place for the annual meeting of December, 1927, remains undecided. The executive committee expressed its conviction that that meeting should be held in a southern city. Places for future summer meetings are undecided.

15. The gift of an oil painting of Dr. H. L. Fairchild was offered to the association by Miss Luella Agnes Owen. The offer was accepted with appreciative thanks.

16. It was voted that the Committee of One Hundred on Scientific Research be reorganized and continued.

17. The president of the association, Dr. J. McKeen Cattell, was elected chairman of the Committee of One Hundred on Scientific Research, and he was authorized to make appointments to fill vacancies on that committee and to name such officers and subcommittees as may be needed.

18. A progress report was accepted from Dr. Otis W. Caldwell, chairman of the special Committee on the Place of Science in Education. The work of this committee is now being taken up vigorously.

19. It was voted that disbursements from the special fund, provided by the Commonwealth Fund of New York, for the study of the place of science in education shall be made by the permanent secretary on vouchers approved by the chairman of the Committee on the Place of Science in Education.

20. The executive committee expressed its hearty approval of the arrangement by which Professor A. S. Eddington, of the University of Cambridge, is to give an evening lecture before the association on the third evening of the approaching fifth Washington meeting, December 31, 1924.

21. It was voted that the Second American Association Prize ($1,000), provided by an anonymous member of the association, be awarded at the close of the fifth Washington meeting in the same manner as was the first prize last year. The second prize is to be awarded for a noteworthy contribution to science presented at the fifth Washington meeting, either before a section of the association or before one of the organizations meeting with the association at that time. Membership in the association will not be considered in selecting the second prize man. Recommendations will be received by the permanent secretary's office during the meeting, from the secretaries of all sections and of all organizations meeting with the association. These recommendations will be used by the Committee on Award of the Second American Association Prize, the membership of which is to be named by the council at its first Washington session, Monday afternoon, December 29. This committee is to consist of five members representing different fields of science.

22. It was voted that a dinner and conference of the members of the executive committee and the association secretaries be arranged for the evening of Sunday, December 28, at Washington.

23. It was voted that the association will be glad to cooperate with the Pan-Pacific Union in any feasible way and a special committee to consider this cooperation was appointed, consisting of Drs. L. O. Howard, Herbert Osborn and B. E. Livingston.

24. It was voted that the association will be glad to cooperate with the National Conference on Outdoor Recreation in any fields in which its work coincides with that of the conference.

25. A letter from the American Museum of Safety, of New York, inviting the members of the association to visit the museum, which has recently been opened, was received with thanks. It was voted that the association heartily approves cooperation with the American Museum of Safety.

26. A letter from one of the members was read, suggesting the desirability of an association section or special program on the Science of Religion, and it was voted that the executive committee felt that, although some such arrangement may perhaps be ultimately desirable, yet it would not be feasible at present.

27. A letter from a member was received, suggesting the desirability of a national burying ground for the association. The executive committee expressed its feeling that such an arrangement would not be feasible.

28. The problem of the nature of fellowship in the association was discussed at length and the special committee on this subject was continued and asked to make recommendations at the next meeting of the executive committee. This committee consists of Drs. L. O. Howard, W. J. Humphreys and B. E. Livingston.

29. The arrangement of the affiliation of state academies was discussed at length and a special committee was appointed to make recommendations for improvement in this important relation at the next meeting of the executive committee. This committee consists of Drs. Herbert Osborn, Henry B. Ward and B. E. Livingston.

30. It was voted that the next meeting of the executive committee be called at 4 o'clock on Sunday, December 28, 1924, at Washington.

BURTON E. LIVINGSTON,
Permanent Secretary

THE NATIONAL ACADEMY OF SCIENCES

THE autumn meeting of the National Academy of Sciences was held on Monday and Tuesday, November 10 and 11, 1924, at Harvard University, Cambridge, Mass., and on Wednesday, November 12, 1924, at the building of the American Academy of Arts and Sciences, Boston.

The scientific program was as follows:

MONDAY, NOVEMBER 10, PIERCE HALL

Morning Session

The absorption of radiation by ozone in the atmosphere: CHARLES FABRY (introduced by S. W. Stratton).

The number of free electrons within a metal: E. H. HALL.

Contact potential difference of metals: E. H. HALL.

Recent measurements of the joule effect for carbon dioxide: F. G. KEYES and F. W. SEARS (introduced by S. W. Stratton).

The facts that influence the activity of atoms in organic compounds (by title): JAMES F. NORRIS (introduced by S. W. Stratton).

An equation for the Haber equilibrium (by title): L. J. GILLESPIE (introduced by S. W. Stratton).

The intensities of X-ray reflection: LOUIS HARRIS (introduced by S. W. Stratton).

The periodical structural regularities of spectra as related to the periodic law of the chemical elements: WILLIAM F. MEGGERS (introduced by G. K. Burgess).

New measurements of planetary radiation and planetary temperature: W. W. COBLENTZ and C. O. LAMPLAND (introduced by G. K. Burgess).

The aërodynamical characteristics of airfoils at high speed: L. L. BRIGGS, G. C. HILL and H. L. DRYDEN (introduced by G. K. Burgess).

The effect of tension on the transverse and longitudinal resistance of metals: P. W. BRIDGMAN.

A device for studying gaseous conduction at low pressures: VANNEVAR BUSH (introduced by S. W. Stratton).

The relativity motion of mercury: CHARLES L. POOR (introduced by G. C. Comstock).

The density of oxygen (by title): G. P. BAXTER and H. W. STARKWEATHER.

A theory for torsional stresses in curved skew bars (by title): PAUL HEYMENS (introduced by Edwin B. Wilson).

Biographical memoir of G. L. Goodale (by title): B. L. ROBINSON.

The spark spectrum of iron, with some remarks on spectral regularities (by title): H. N. RUSSELL.

Afternoon Session

The Cordierite-anthophyllite mineralization at Blue Hill, Maine, and its relation to similar occurrences: WALDEMAR LINDGREN.

Gel replacement, a new aspect of metasomatism: WALDEMAR LINDGREN.

Results of recent investigations of the form of the continental shelf bordering Eastern North America: DOUGLAS JOHNSON (introduced by J. F. Kemp).

The occurrence of Cordilleran and other Western plants in Eastern America (illustrated): M. L. FERNALD (introduced by B. L. Robinson).

Remarks on the glacial geology of Martha's Vineyard island: EDWARD WIGGLESWORTH (introduced by W. Lindgren).

Recent work in oceanography: HENRY BIGELOW (introduced by E. L. Mark).

The new research station on Barro Colorado Island in Gatun Lake: THOMAS BARBOUR (introduced by W. M. Wheeler).

Biological characters in the differentiation of Avian Coccidia: E. E. TYZZER (introduced by Reid Hunt).

Summary of results thus far obtained by the Third Asiatic Expedition of the American Museum: H. F. OSBORN.

The five chief factors in evolution: H. F. OSBORN.

TUESDAY, NOVEMBER 11, PIERCE HALL

Morning Session

Heat of formation of nitrogen trichloride: W. A. NOYES and W. F. TULEY.

Internal pressures produced by chemical affinity: THEODORE RICHARDS.

Studies in catalysis: H. W. SHERWOOD, JR. (introduced by S. W. Stratton).

The mechanism of reactions in the urea series: T. L. DAVIS (introduced by S. W. Stratton).

The manner of occurrence of caffein in the coffee bean: S. C. PRESCOTT (introduced by S. W. Stratton).

On crystallized animal proteins: E. J. COHN (introduced by L. J. Henderson).

Characterization of proteins: S. R. L. SÖRENSEN (introduced by A. B. Lamb).

Afternoon Session

On multiple relations: A. N. WHITEHEAD, F.R.S. (by invitation).

Doubtful measurements: J. L. COOLIDGE (introduced by H. S. White).

Geometries defined by a linear differential form: C. L. E. MOORE (introduced by S. W. Stratton).

The frequency distribution on apparent magnitude of the non-Magellanic O-type stars: E. B. WILSON and W. J. LUYTEN.

The age of the stars (by title): EDWARD CONDON (introduced by A. O. Leuschner).

The population of New York City and its environs: E. B. WILSON and W. J. LUYTEN.

Tidal oscillation of the Lava Lake of Kilauea: E. W. BROWN.

Time constants: E. A. KENNELLY.

Controlled orbital transfers of electrons in optically excited mercury atoms: R. W. WOOD.

Influence of strain and of heat on the hardness of iron and steel: ALBERT SAUVEUR (introduced by G. F. Swain).

Regarding the experiments of Hiram F. Mills on the flow of water in pipes: G. F. SWAIN.

A problem of electric power transmission: D. C. JACKSON (introduced by S. W. Stratton).

Drowning period of crocodiles: G. H. PARKER.

Experiments on medulla and spinal cord grafts in embryos: S. R. DETWEILER (introduced by G. H. Parker).

The finding of the Queen of Eciton Hamatum Fabricus: W. M. WHEELER.

WEDNESDAY, NOVEMBER 12, AT 28 NEWBURY STREET, BOSTON

Morning Session

Bacterial allergy: HANS ZINSSER.

The diffusing capacity of the capillary bed: L. J. HENDERSON and C. D. MURRAY.

Skew growth curves: R. PEARL and L. J. REED.

The influence of diet upon the growth and structure of the kidney: T. B. OSBORNE, L. B. MENDEL, E. A. PARK and M. C. WINTERNITZ.

The effect of small amounts of fluorine in the diet of the rat: E. V. MCCOLLUM.

The skin temperature of men and women: F. G. BENEDICT.

Prolonged fasting of steers as affecting the constituents of urine: T. M. CARPENTER (introduced by F. G. Benedict).

Chemical studies in tuberculin: J. H. MUELLER (introduced by H. Zinsser).

Some effects of arsonium, stibonium and analogous compounds on the autonomic nervous system: REID HUNT and R. R. RENSHAW.

Virus encephalitis in the rabbit: SIMON FLEXNER.

The cultivation of the dysentery amoeba: W. C. BOECK (introduced by R. Hunt).

Gaseous interchanges in the stomach and intestine: M. A. MCIVER (introduced by W. W. Cannon).

Conduction without decrement in narcotized nerve: ALEXANDER FORBES and HALLOWELL DAVIS (introduced by W. B. Cannon).

Afternoon Session

The respiratory function of the hemocyanins: A. C. REDFIELD and A. L. HURD (introduced by W. B. Cannon).

Studies in the life history of Artemia sabina principalis, Simon: G. G. MARTIN (introduced by W. B. Cannon).

On the occurrence in rabbits of linkage inheritance between albinism and brown pigmentation: W. E. CASTLE.

The nature of association between Anthozoa and Zooxanthellae: H. BOSCHMA (introduced by E. L. Mark).

Symbiosis between Chlorella sp. and Azotobacter chroococcum and nitrogen fixation: C. B. LIPMAN and L. J. H. TEAKLE (introduced by A. O. Leuschner).

Localized form-controlling agencies in hydra and planaria: H. W. RAND (introduced by G. H. Parker).

Some peculiarities in the distribution of New England flies: C. W. JOHNSON (introduced by W. M. Wheeler).

Certain aspects of the sugar cane disease in Cuba: W. H. WESTON (introduced by W. J. V. Osterhout).

Recent aspects of Central America orchid flora: O. AMES (introduced by B. L. Robinson).

Hybridism in the genus Isöetes: E. C. JEFFREY (introduced by G. H. Parker).

The gorilla in the Eastern limits of its range: J. C. PHILLIPS (introduced by W. E. Castle).

The dispersal of the bats of the genus Microtis: G. M. ALLEN (introduced by L. Stejneger).

The British Museum collection of recent sea-urchins: H. L. CLARK (introduced by G. H. Parker).

Observations on the fauna of thermal waters: C. T. BRUES (introduced by W. M. Wheeler).

Differences in the physico-chemical composition of the cells of the central nervous system as revealed by specific impregnation methods (by title): HARVEY CUSHING and PERCIVAL BAILEY.

Formation of urine by the kidneys (by title): JOSEPH T. WEARN (introduced by H. Zinsser).

Evening Session

Being the one thousand one hundred and thirty-fourth meeting of the American Academy of Arts and Sciences.

Spread of ideas in the Middle Ages (discussion by H. O. Taylor): C. H. HASKINS (by invitation).

Some causes of volcanic activity: ARTHUR L. DAY.

SCIENCE

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CONTENTS

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ADDRESS AT THE EDWARD HART CELEBRATION[1]

THIS is a grand occasion, yes, that and much more! And those gathered here are happy. Especially is this true of the chemists in the audience, because it is one of their guild whose completion of the fiftieth milestone in his career as teacher, investigator, printer and manufacturer is at hand, and they proudly rejoice for

> Judge him by no more than what you know
> Ingenuously, and by the right laid line
> Of truth, he will indeed all styles deserve
> Of wise, just, good and true!

But they who've so affectionately arranged this assemblage advised the speakers of the hour to tell something of chemistry in America. Heeding this injunction—free to descant on any phase of the huge, all-embracing subject—this particular speaker, craving your sympathetic indulgence, will hie him back —pretty far back—into the past, for there are some things which "if gathered from the ashes of obscurity" prove interesting, illuminating and worth while.

The wily Subtle, in Ben Jonson's "Alchemist," shrewdly said:

> All arts have still had, Sir, their adversaries;
> But ours the most ignorant,—

True! For there were innumerable, unconscionable charlatans among the professors and practitioners of the alchemic art, whose shameful practices brought the craft into general disrepute. They were the *adversaries* of the simple, sincere devotees who had learned to scorn delights and live laborious days in search of the all-powerful transmuting agent, yet not blind to other new and marvelous changes occurring in their crude, primitive furnaces. Nor did these enthusiasts live in European lands alone. They existed here in America. We who've taught chemistry probably never knew this. We imagined that our science, freed from its early shackles of ignorance, and superstition, proudly stalked through the land untouched, untainted by those "close deeds of darkness, that shun the light!"

No, it is recorded that John Winthrop, the younger, erstwhile governor of Connecticut, living in New London, somewhere in the late sixteen hundreds, used to resort with his servant to Governor's Ring—a

[1] Address delivered on the occasion of the Edward Hart celebration at Lafayette College, October 16, 1924.

mountain in the northwest corner of East Haddam, and after spending three weeks in the woods of this mountain, roasting ores and assaying metals and casting gold rings, he used to return to New London with plenty of gold.

Governor Winthrop was an alchemist and an intimate correspondent of Sir Kenelm Digby—first alchemist in England in his day! Such is the legend on one side of the shield; turn it, and the inscription reads:

> This same Governor Winthrop—the Younger—found plenty of cobalt, which he made into smalt—used in the beautiful blue and China ware. He sought for and obtained zinc, antimony, copper, mercury and iron. Furnaces for the reduction of ores of iron were erected and operated at his command near his home in Connecticut. Winthrop cherished the desire to aid and improve the arts among the people of his Colony.

And there were other respectable alchemists scattered throughout the land now known as the United States. Indeed, they were here—or not far from here—over in the blue mountains of the Lehigh where the people were all the time dreaming of mines and sudden wealth; the German settlers particularly helping to keep the strange hopes alive. Even the farmers, having brought with them their stories of Kobolds and mountain sprites, and treasures lit, declared that in the winter night—"beneath that arch of unmoved and eternal lights"—they still heard the hill homunculi working and knocking—saw the telltale flames, but unluckily could never discover the spots where the mysterious activities described were enacted. Who knows—who dare deny—but what these activities in by-past times, occurring through this beautiful valley, were in some intangible way busy when in July, 1778, Robert Levers said that "the price of iron at Chelsea forge [right here in Easton] was 200 pounds a ton, an advance of 100 per cent. on the price paid by the State a short time previous," and informed "the Council of Easton that Bar-iron could probably be sold to blacksmiths in the neighborhood at 300 pounds a ton."

However, perhaps enough has been said of the alchemists in our land. Their memories should be cherished and passing thought, at least, be given their endeavors, for the latter are truly part of the evolution of civilization in this western world.

In 1683 William Penn, eager for the extension of the reputation of his province, wrote enthusiastically to Lord North of "the minerals of copper and iron in divers places." And, close thereafter (1698) Gabriel Thomas stated in writing that iron had lately been found which far exceeded that in England, being richer and less drossy; copper—far exceeding ours, being richer, finer and of a more glorious color, and further observed:

> Backward in the country lie the mines, which is copper and minerals of which there is some improvement made already in order to bring them to greater perfection. And they will be a means to erect inland Market Towns which exceedingly promote Traffic.

And wise James Logan, secretary of the province, had it impressed upon him

> To remember the mines which the Governor makes yet a secret, even to thee and all the world but himself and Mitchell.

These thrifty, far-seeing, worldly-wise improvers of the alchemical methods adopted to oblige mother earth to reveal her precious treasures were confronted on the way, from time to time, by annoying obstacles and hindrances. Thus, the assembly of the province was petitioned in 1723 by the proprietors of iron works to prohibit the retailing of liquor, except cider and beer, near their works to the workmen!

The picture may now be slightly changed. It is in the last two decades of seventeen hundred. Chemistry, the science, was fast gaining place. Intelligent people realized that, in the revolutionary days, it had rendered a service which could not easily be measured. Even the immortal Washington during his severest military activity had paused to test the toxicity of gases, observed issuing at frequent intervals, from creeks and rivers in which his horses and men had slaked their thirst. All the while he was alert. On the restoration of peace he studied the little industries springing up through the infant republic. Franklin, the practical, had passed on, so Washington, intensely interested and eager, sought by every means to promote the welfare of his people. Wide reading, conversation and correspondence had brought to his attention that in the darkest hours of the Reign of Terror and in the later years when France was growing into a mighty power among the nations of Europe, there was a chemist—Chaptal by name—who had executed most remarkable things; among others, the building up of far-reaching industries based on chemical principles. Chaptal's fame had extended to many lands, whose rulers vied with one another to gain his services. At the time, there were men in America who had known Chaptal personally or had learned to know him through his remarkable writings and books, bringing the new gospel which scholars proposed to offer to industry. These men it was who urged Washington to win Chaptal for America. The result of the effort is told in Chaptal's autobiography:

Finally, the celebrated Washington, then President of the United States, wrote me twice on the subject. In the first letter he made this statement: Although I am the President of the United States, I have not the power to enter into an agreement with you in regard to salary; but useful men, such as yourself, are not abandoned in my Country. Come, and you yourself will be more than pleased by your welcome.

Chaptal did not come.

No doubt there has been in every one of us the unexpressed wish that he might have been about in those early days of the republic, for there is no question that the launching of chemical industrial projects was much on the minds of the people. They were industriously engaged in making nature's products useful, and in the language of old Dr. John de Normandie:

When we want the testimony of experience, a chymical analysis is the best means of investigating the truth.

As one turns the pages of old newspapers, peering into every column and corner, facts appear which illuminate the path of our progress in civilization. Thus there came to the speaker's attention that in 1793, in Philadelphia, one John Harrison was manufacturing oil of vitriol with much success, and was also the first person to attempt the production of nitric acid in the United States. The city directory of that period reveals John Harrison, as druggist and *aqua fortis* manufacturer. But greatly encouraged by his development in the chemistry of these acids he abandoned the apothecary and drug business, so that in the directory of Philadelphia for 1806 he was set down as *chymist* at 75 North 5th Street.

America is greatly indebted to this Englishman—John Harrison—who conducted the vitriol industry with marked ability. All this led naturally to an extension of his activities into other fields of chemical manufacture, with which he had familiarized himself, and which he was enabled to do by the aid of educated foreigners such as Abraham Kunzi, a Swiss, and others. In those days this country was overrun with foreigners, some of whom had been merely laborers in laboratories abroad, with no knowledge of chemistry as a science, and whose skill was confined to their own limited routine work. However, there were men of higher character, of competent education as chemists and of much intelligence. Such were John Farr, Gerard Troost and Eric Bollman. The last of these—Eric Bollman—did a neat piece of work for Harrison, who, like others in those days, concentrated his vitriol in large vessels of glass. The particular favor done for Harrison consisted in working bar platinum into sheets more than 13 inches square, then applying those sheets to the making of a platinum still, weighing seven hundred ounces, with a capacity of 25 gallons, which was employed for acid concentration, by Harrison, for fifteen years! Bollman, a most interesting individual, was indeed a chemist. He plated copper and iron with platinum, and with ease prepared the silver-colored metallic luster or glaze for porcelain with its oxide. Our early chemical books quote him freely. His knowledge had, of course, been acquired in foreign countries. He had won his M. D. degree at Goettingen in 1794 and it was there, under the guidance and inspiration of J. F. Gmelin, the chemical historian, that he had acquired his love for chemistry, his knowledge of which was augmented by travel years in France, Austria and lands where the science was conducted by masters.

Bollman was a Dane with a powerful and versatile mind. He was a political economist and scholar. His writings on economics gave old Dr. Thomas Cooper much concern, and yet these two men were singularly alike in many respects. There was in both a turbulent, radical, revolutionary spirit. Both were members of the Convention in the French Revolution, and Bollman after banishment to this country was, in 1806, deeply implicated in the conspiracy of Aaron Burr. His complete absorption in scientific pursuits developed after coming to this land. His earlier adventurous career had afforded little opportunity for deep thought. Considering the many contributions of Eric Bollman to the infant chemical industries of this country, perfectly well satisfied that they possessed great merit and accelerated old and inspired new undertakings, one conversant in a measure with this extraordinary man's mental predilections is not shocked or even surprised, but merely intensely and sympathetically interested, on hearing for the first time that Eric Bollman and a young American accomplice actually ventured to rescue General Lafayette from close confinement in the prison into which he had been cast in Olmutz, Austria, because of his supposed connection with the insulting degradation and subsequent death of the royal family of France. The recital of this stirring event would probably weary you. But, don't forget that the chief actor was a brother chemist—one who subsequently stood among the first of our American fathers in the science. The escapade, as narrated in old journals, such as the *Edinburgh Annual Register,* is most thrilling! It failed, and those engaged therein were incarcerated, gaining freedom only after the intervention of Napoleon! Think for a moment—we sit in the shadow of a college whose patron saint was Lafayette, once idolized by an enthusiastic populace, raised to the chief command of his emancipated coun-

trymen; then proscribed and hunted by associates; a fugitive in a foreign land, obliged to seek an asylum amongst his enemies, after combatting for the cause of liberty under the banners of Washington, and lastly, seized as a traitor and delivered up to the Emperor of Germany, who threw him into prison, from which one of our craft, Eric Bollman, risked his all and suffered unspeakable torments, that he might set free the idol of his young manhood!

Even chemistry has had its romances.

Other pictures might easily be sketched before you. Their novelty and their display of technical skill would promptly arouse earnest thought and profound mental absorption. But they would lead us far afield. The line of demarcation between past and present would fade into nothingness, and those interested would be surprised and yet happy to hear that the War of 1812, with the commercial restrictions preceding it, caused such a scarcity and dearness of the more prominent and valuable substances, so that one may safely declare the reestablishment of chemical manufactures dates from this time (1812). Foreigners conversant with chemical procedures in German, French or English factories were among the very first to undertake these ventures. Capitalists among our own druggists engaged this foreign skill that their own works might again be brought into operation, so that ere long factories for the making of Prussian blue, Scheele's green and other pigments, and heavy chemicals were quite rapidly inaugurated; hence 93 years ago thirty chemical establishments were in operation in the United States, with an aggregate capital of $1,158,000 and an annual output valued at not less than $1,000,000. Those fostering these undertakings had heeded the injunction of the chemically wise:

> Thrust in thy sickle, and reap; for the time is come for thee to reap! The harvest of the earth and factory is ripe.

And thus runs the story of our science with its many divergent lines. We cherish it, for experience has told us "to hold each strange tale devoutly true."

And how are we to adequately express our joy at the achievements of our friend whose fiftieth milestone in the cultivation of his favorite science is now reached? We have followed him through all his years as student, teacher and industrialist. We've rejoiced in his success, known to the world, and observing his still youthful step—his keen interest and intelligence in the multitudinous activities on every side, we're sure he contemplates even greater things in the coming years. So we'll content ourself by saying—

> Press on, true soul!
> Thou wilt win the prize.
> Thou wilt reach the goal!

University of Pennsylvania Edgar F. Smith

FIFTY YEARS OF CHEMISTRY IN AMERICA[1]

We are accustomed to thinking of our country as young, and so it is when compared in point of years with China. Its beginnings were extremely modest and its future to those who founded it must have been very doubtful, in spite of their courageous optimism. It took years to establish even an approximately firm foothold and a great many more years to solidly establish the position. When we look back upon the work of the early comers we can not but admire their dauntless courage, their industry, their thrift, their prudence. Our whole nation was built upon these and similar virtues, and I hope it will never come to pass that the uneasy quest for what is glibly termed progress will tempt us to look elsewhere than to eternal verities for the real progress of the nation.

Our forebears with everything to do and very little to do it with recognized the supreme importance of educating their children, and very early in their history institutions of higher learning were established. As they progressed with the building of a nation, the need of education became more and more clear, and institution after institution was founded, usually with very slight means, in order that higher education should advance and be more generally obtainable. One hundred years ago, Lafayette College was thus established, and you are to-day celebrating this fact with commendable pride and exultation. The history of the college has been a splendid one and its future is assured. Its long list of honored teachers and distinguished alumni is a visible sign of the success of its work. Its influences, however, which are not visible and are not even known, can not be measured. I congratulate the college on its history and on its work.

During the last half of its life, a man has been associated with the faculty who has made his mark not only within these walls, but outside of them. It is not my purpose to go beyond my text and deliver a eulogy of Edward Hart, but I desire to add my testimony to that of many others who have known him well during that time and appreciate his faithfulness, efficiency and singleness of purpose, happily joined with a saving sense of humor. The college does well in celebrating at its centennial time the semi-centennial of this worthy man's connection with the institution.

It is appropriate in honoring this man who, during the fifty years, has been constantly teaching chemistry and adding to its theoretical and prac-

[1] Address in connection with the celebration of Professor Edward Hart's fifty years of continuous service in the department of chemistry, Lafayette College, October 16, 1924.

tical knowledge, to consider what fifty years have done in this country for the science of chemistry and its application and what chemistry in turn has done for the country. Some of us can look back to the beginning of the period, as we so often do, not only with a feeling of amusement at what existed then but with astonishment at what has happened since. It is true that all branches of engineering and scientific knowledge have progressed tremendously hand in hand, but I think it must be admitted that chemistry has not only done its share but has greatly helped the other sciences to achieve what they have done. The whole progress has been colossal, but I wonder when Professor Hart's centennial is being celebrated whether the chemists of that day will not look back upon us of to-day with the same feeling of amusement at our lack of knowledge and the expensive mistakes which we have unwittingly and ignorantly committed.

In discussing fifty years of chemistry in America, there are so many points of view that the subject can not be covered within the limits of a short address, or even within the limits of a five-foot bookshelf. The historical side, the teaching side, the scientific side, any one is so full of interest that all deserve especial consideration. It is my purpose to speak briefly on the technical side without attempting anything in the way of dates and figures which in themselves would take up all the time allotted to me, besides being very dry hearing. I will lightly touch on a few of the high spots, realizing that there are very many which I will not even mention and realizing also that those I do mention are not complete or likely to be within my lifetime. I have seen a great many chemical problems solved, but I have never seen one that was solved so completely that there was no room left for improvement. Having this in mind, it would therefore be useless to attempt chronological order, and of course it would be foolish to endeavor to align them in the order of merit or importance, as no one can tell how the unimportant things of to-day may become the great and vital things of to-morrow.

I have always called sulfuric acid the pigiron of technical chemistry. Its uses are innumerable and its importance is vital. Fifty years ago this industry was practically in its infancy. Nothing was known beyond the simple chamber process, and no two manufacturers agreed as to the standard content of H_2SO_4. 66° acid ran all the way from 66° to 65°, or even less. The discovery of petroleum and its refining soon showed the importance of a standard high strength. For a number of years, the improvements in the chamber process, including concentration to 66° Be, and a trifle higher, were continuous and more or less secret. The revolution came when an acid of much higher strength—fuming acid—was needed in the arts and therefore had to be produced. A London firm, as far as I can ascertain, was the original producer in a large way of fuming sulfuric acid, by what is known as the contact process. When the requirements of the coal tar dye industry in Germany indicated need of something as strong as what was known as Nordhausen acid, but necessarily much cheaper, this firm exported it to that country. This condition could not last long, as the requirements were too large and too important. Many of you will remember the remarkable paper of Kneitsch which demonstrated the fact that investigators in Germany were alive to the situation and met it splendidly. It remained, however, for this country to develop the best process for the manufacture of this highly important material which lays at the foundation of our own needs for the treatment of certain petroleum distillates, for the great dye industry which has developed here, for high explosives, and unhappily for the manufacture of poison gases which "man's inhumanity to man" brought so prominently and unexpectedly before us during the World War. Fortunately for all these purposes, and others to which I will not allude, the production of fuming sulfuric acid in this country had become larger in 1914 than in any other country in the world and, I think I may add, more efficient.

In considering sulfuric acid, we should not lose sight of the brilliant work done by Herman Frasch in unlocking the tremendous sulfur deposits in Louisiana and Texas. Enormous quantities were known to exist, but until Frasch discovered the way, no one was able to economically withdraw them from their resting place. Thanks to Frasch, to-day the output is enormous, the process well understood and our country is placed far in the lead of the rest of the world in the production of this absolutely necessary chemical.

Another accomplishment must be mentioned, namely, the production of soda ash by what is known as the Solvay (or ammonia-soda) process.

While it is true that this process was conceived sixty odd years ago, its great improvements and refinements have taken place during the last forty years. To-day soda ash is made almost exclusively by that process and has been brought to an astonishingly cheap cost of production if we may judge by its selling price. When we consider the importance of the industries which have been fostered on the strength of this cheap and pure chemical, we must give the process a high place in the accomplishments of the last fifty years.

Petroleum and its distillates come strictly under

the head of chemicals. This whole industry has been developed practically during the last fifty years. Fortunately, the first petroleum discovered was of a comparatively simple composition and methods for its refining were soon devised. The growth of the demand for these products and the discovery of oil in many different localities, all with different compositions, made the problem more complex and more interesting. The difficulties of the industry were greatly increased by the lack of balance of the demand. As an example, I will mention an interview I had with one of the high officials of the largest refining company, during which he told me of the extreme difficulty of disposing of the lighter fractions. What the people wanted was kerosene and lubricating oils; what they didn't want was gasolene. He told me he was at his wits' end to know what to do with gasolene. A few years later I had another interview with the same official and he told me the trouble now was to get gasolene enough. As you know, the invention of the internal combustion engine revolutionized not only the oil industry but a good many others, but what made the internal combustion engine possible? Various devices, including cracking, were resorted to, in order to increase the production of that fraction which a few years before had been a drug. Fortunately, this key industry is much better understood to-day than even twenty years ago, and I have no doubt that those engaged in it will be equal to the problems which the future has in store, and these are both numerous and difficult.

Fifty years ago, by-product coke ovens were in their infancy. Coke was made in beehive ovens, and everything in the coal, except the coke, was lost. The by-product ovens, as the name indicates, made available a good deal of the wealth which had been so carelessly wasted and to-day give us large volumes of illuminating gas, ammonia for the farmer, benzene, toluene, naphthalene, etc., for the dye-maker, tar for the roofer and road-maker, and of course the coke which was the primary objective.

During these fifty years another astonishing thing was done which had a most dominating influence upon the electrical industry in all its branches. I allude to the refining of copper by electrolysis—an industry which has assumed majestic proportions and furnishes nearly all the "red metal" used in the world. Long after Professor Hart came to Lafayette, little was known of the metallurgy of copper, and no one knew how to analyze it without an error sufficiently large to make the industry in its present state impossible. The producers of copper and its ores, realizing this fundamental difficulty, wrote to a number of chemists to see if it were possible to suggest a method of analysis which would be absolutely correct and therefore enable one chemist to check another. The accepted method was worked out in a Long Island laboratory and was based upon the idea that all the copper in an ore or other substance could be electrically deposited upon a platinum cathode, and its increased weight after the copper had been deposited would show the actual weight of the copper in the given quantity of material under consideration. This method with certain refinements to increase its accuracy has been in use ever since. The question was naturally raised, if you can thus deposit a gram, you can deposit a pound or a ton, or a thousand tons, and this was the foundation of the electrolytic copper industry. Being put into practice, another fact was developed which was not noted in the laboratory when dealing with small quantities. The mud which settled at the bottom of the electrolyte was found to contain all the silver and gold, platinum, palladium and other valuable impurities contained in the ore, in more or less minute quantities. The recovery of these residues has saved to the world many hundreds of millions of dollars of gold and silver which otherwise would have gone forth as impurities in the copper. Electrolytic copper itself, on account of its extreme purity, has rendered valiant aid to the working out of the complex problems of the electrical engineer and research worker. Of this period, therefore, we have to record that the electrolytic copper industry of the world and all that that implies was born in a chemist's laboratory and brought up to its present state of efficiency with little delay.

We all remember Sir William Perkin's discovery of mauve, the importance of which does not seem to have been appreciated by the inventor himself or by any of his countrymen. The study of what led to the great industry of coal-tar dyes and organic remedial agents was left largely to the Germans, who seem to have appreciated the importance of the work and made good use of the start they acquired. The by-product coke ovens had made the raw material available for large operations, cheap sulfuric acid and soda ash were also obtainable, but the German chemists are entitled to great credit for what they did with these factors. The war brought to our attention with stunning force the fact that an industry of vital importance for both peace and war had been allowed to get into the hands practically of one nation. Fortunately, necessity being the mother of invention, we in this country met that problem man fashion and have worked it out in a manner deserving the highest praise. This is not the time or place for a disquisition on the importance of synthetic organic chemistry, but it is a very appropriate place to say that in the future we need have little fear that

our country will fall behind in the great procession. Given a pressing need, and the American chemist has never been found wanting in the past, and this to my mind is abundant augury for the future.

One of the most recent triumphs of chemistry is the practical solution of that essential problem—the fixation of atmospheric nitrogen in a form that enables us to use this lazy gas in some of its very active and energetic combinations. Nature has supplied unlimited quantities of it in the air we breathe, and during eons of time has fixed some of it in such familiar substances as coal and nitrate of soda. But to man it was impossible to utilize this vast storehouse of wealth, although it was realized that in time it would be imperative that he should do so. The first partially successful attempt was by Bradley and Lovejoy in their little experimental plant at Niagara Falls. They proved that under certain conditions the nitrogen of the air could be chemically united with its oxygen. Like many another pioneer, they pointed to a fact, but could not make the knowledge lead to a financial success. Their work, however, made others think along oxidation lines made possible by electrical discoveries, and to-day Norway's remarkable hydro-electric conditions yield the world large quantities of nitrates. The oxidation of atmospheric nitrogen became therefore practicable where electric power is cheaply installed and where other uses for it are lacking. In a country like our own, with factories on all sides demanding power and willing to pay much more for it than the nitrogen industry can possibly afford, I do not see any likelihood of the successful establishment of the electric arc process here in spite of all we read about Muscle Shoals. But it is a pleasant task to state that the fixation problem was solved, even if what seemed to be a better way came later.

And what is this better way? Professor Haber and his associates found that nitrogen would unite with hydrogen, in the form of ammonia, under high pressure in the presence of that "still small voice" of chemistry, a catalyst. Ostwald found that with another catalyst, the hydrogen could be easily displaced by oxygen, making nitric acid, and there you are! These two facts made the great war certain, and extended it three years longer than it otherwise would have lasted. Professor Haber told me recently that his attention was attracted to this matter and the possibility of its solution when visiting the little plant at Niagara Falls to which I have alluded. "Behold, what a great matter a little fire kindleth."

We are not behind in this vital question in our own country. One plant has been in successful operation for more than three years, and others are starting. If, unhappily, war conditions should arise, we have the patriotic satisfaction of knowing that the materials for carrying on war are all within our own borders. This knowledge should go a long way towards preventing the necessity of thus using our resources, but it is nevertheless a pleasant thing to know that they exist.

Naturally, the peace uses of nitrogen are far more important and pressing. Peace is our usual condition, thank God! and war is a hideous excrescence which should be and will be made impossible, if not by the improvement of human nature, which is the best way, then by the advance in scientific knowledge which may mean the suicide of the race—a silly alternative.

I have briefly touched on a few of the revolutionary accomplishments of applied chemistry, during the last half century. There are many more. While the chemist can point to them all with pardonable pride, he will not, I am sure, forget the important assistance rendered by the engineer. The problems have been large enough to require all sorts of talent for their solution—another instance of the value of cooperation.

In view of what fifty years have accomplished with, at the beginning, very little knowledge shared by comparatively a few men, what may not be expected of the next fifty years with present knowledge possessed by a vast army? There is abundant room for the imagination. I will venture only one prediction. The most elaborate and delicate chemical works ever devised is the human body. Much has already been done by the chemist in delving into its secrets. Positive results have been obtained which have almost annihilated certain diseases and modified others. I predict that during the next half century, the chemist, working hand in hand with the physician, will discover the origin and nature of most of the enemies of the human body, notably that arch-enemy, cancer, and not only alleviate their effects but absolutely prevent their sinister operations. Then indeed will the human race be relieved of some of its heaviest handicaps, and be freer to progress towards the light of truth which is its principal business, for we have it on the highest authority that "the truth will make you free."

Wm. H. Nichols

New York, N. Y.

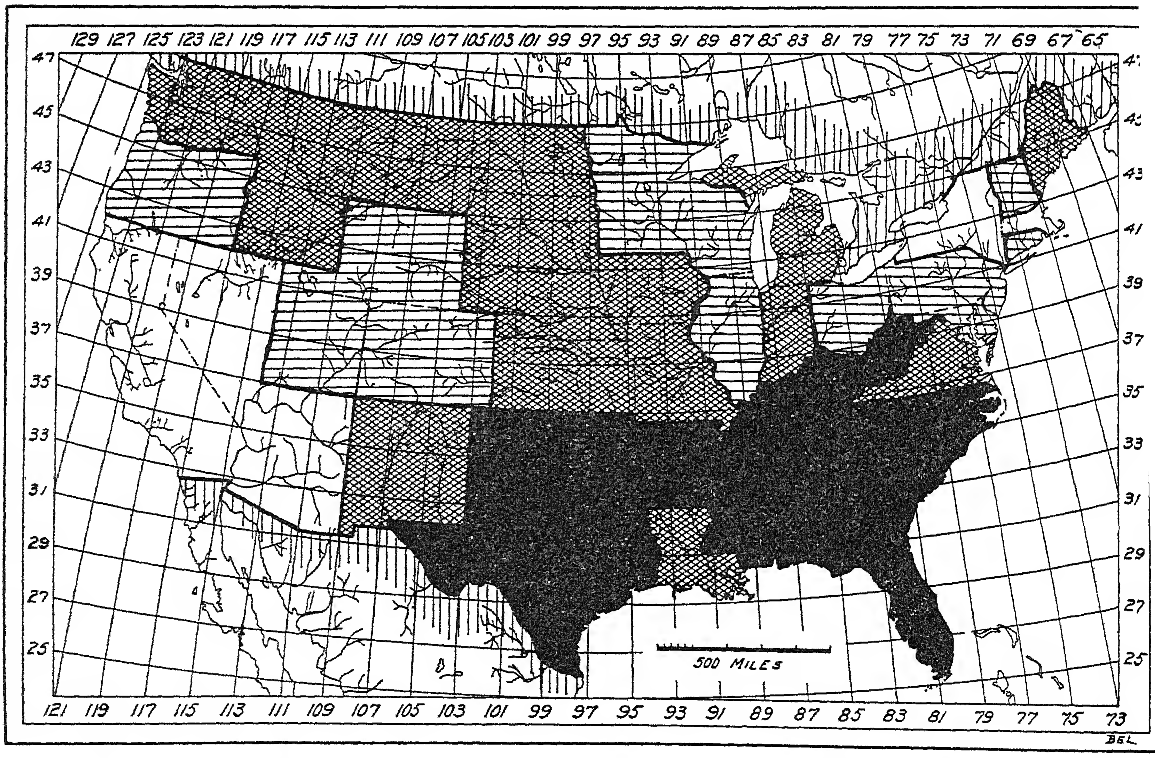
MEMBERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE PER MILLION OF POPULATION IN THE UNITED STATES

Some results of a study of the geographical distribution of the membership of the American Association for the Advancement of Science, with special

reference to its relation to state populations as shown by the official Census of 1920, are of interest in connection with special efforts that are being made this year to increase the membership of the association. I have divided the association enrollment (of March 31, 1924) for each state of the United States by a number representing the state population expressed in whole millions. The resulting quotients may be called American Association membership indices. These indices are shown below, together with the corresponding state enrollment figures. They are arranged in increasing order of the index values.

DISTRIBUTION OF MEMBERS OF THE A. A. A. S.

State	Per million population	Total enrollment
Mississippi	16.8	30
Arkansas	17.7	31
Alabama	21.3	50
Tennessee	22.7	53
Georgia	27.0	78
South Carolina	28.0	47
Texas	39.0	182
North Carolina	40.3	103
Kentucky	42.2	102
West Virginia	43.0	63
Oklahoma	46.4	94
Florida	46.5	45
North Dakota	52.6	34
Alaska	54.6	3
Louisiana	59.5	107
South Dakota	59.7	38
Indiana	65.9	193
Virginia	66.3	153
New Mexico	66.7	24
Idaho	71.8	31
Montana	76.5	42
Missouri	80.2	273
Maine	84.6	65
Michigan	86.7	334
Kansas	90.3	142
Washington	91.4	124
Nebraska	91.8	119
Iowa	96.9	233
Pennsylvania	100.0	872
Minnesota	100.5	240
Oregon	102.2	80
Wyoming	103.1	20
Wisconsin	103.8	273
Ohio	111.1	640
New Jersey	112.2	354
Vermont	116.5	41
Rhode Island	129.1	78
Colorado	129.8	122
Illinois	131.7	854
New Hampshire	140.0	62
Utah	149.2	67
Delaware	174.9	39
Maryland	191.7	278



DISTRIBUTION OF THE MEMBERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

DISTRIBUTION OF MEMBERS OF THE A. A. A. S.

State	Per million population	Total enrollment
Connecticut	192.6	266
New York	208.1	2,161
Massachusetts	218.3	841
Arizona	248.5	83
Nevada	259.7	20
California	268.2	919
District of Columbia	1,383.6	606

What characteristics of our membership and of the various state populations may be disclosed by this array of figures and what may be the geographic, historical and cultural reasons for their arrangement may be left to the reader's judgment. The accompanying chart of the United States is the result of plotting the index values in four groups or ranges—*high* (unshaded), *high-medium* (horizontal hatching), *low-medium* (double hatching) and *low* (black). The District of Columbia presents a special case (with its very great association enrollment and its small population) and its membership index should not be considered as at all coordinate with the others. It is consequently left out of account in the plotting.

High membership indices (over 200 members per million of population) occur for two separated areas: (1) the area of California, Nevada and Arizona, and (2) that of New York and Massachusetts. High-medium indices (100 to 200 members per million of population) are shown for Oregon, Wyoming, Utah, Colorado, Minnesota, Wisconsin, Illinois, Ohio, Pennsylvania, Maryland, Delaware, New Jersey, Connecticut, Rhode Island, Vermont and New Hampshire. Connecticut and Maryland are almost within the high range. Low-medium indices (between 50 and 100 members per million of population) represent Alaska, Washington, Idaho, Montana, North Dakota, South Dakota, Nebraska, Kansas, New Mexico, Iowa, Missouri, Louisiana, Michigan, Indiana, Virginia and Maine. Low indices (less than 50 members per million of population) are shown for Oklahoma, Texas, Arkansas, Kentucky, West Virginia, Tennessee, Mississippi, Alabama, North Carolina, South Carolina, Georgia and Florida. At the time these calculations were made the total enrollment of the association in the United States was 11,709, which gives an average association membership index of 110.7. The average is closely approximated by the index for Ohio (111.1).

With regard to the enrollment numbers themselves (the last column of the table), only three members reside in Alaska and only 20 in Wyoming and in Nevada. The largest enrollment (2,161) is for New York, which is followed by California (919), Pennsylvania (872) and Illinois (854).

Due partly to special invitation letters sent out from the permanent secretary's office and doubtless partly to the great success of recent meetings and the increasingly representative publicity given to the association by the daily press, the membership roll has been greatly increased during the last year. At the close of the fiscal year 1922–23 (September 30, 1923) the total association enrollment was 11,704. On September 30, 1924, it was 12,887. During the fiscal year just closed there have been 121 recorded deaths among the members and 670 members are shown to have resigned or have allowed their membership to lapse by non-payment of dues for two years.

The special arrangement in celebration of the passing of the seventy-fifth year since the founding of the association, an arrangement by which any member of an affiliated organization may join the American Association for the Advancement of Science without payment of the usual five-dollar entrance fee, will remain available until next January 1.

BURTON E. LIVINGSTON

SCIENTIFIC EVENTS

NEW COLLECTION OF PALEOLITHIC MATERIAL AT THE LOGAN MUSEUM OF BELOIT COLLEGE

THE Logan Museum of Beloit College has secured, through the efforts of Mr. Alonzo W. Pond, a large collection of Paleolithic and Neolithic materials from Europe. Some of the more important portions of the collection are as follows:

Thirty-six carvings on stone from Limeuil, France. These are of the Magdalenian period and were the first portable carvings on stone to be discovered in the Paleolithic stations of Europe. Later, search was made in the débris of La Madeleine and similar work discovered. The carvings from La Madeleine and those from Limeuil are all in the National Museum at Paris except this collection now in the Logan Museum. The carvings represent the typical animals of the Magdalenian period, such as the horse, reindeer, bison and the ur. This important collection was secured through the courtesy of Dr. Frank G. Logan, of Chicago, who financed the special purchasing expedition sent out by the Logan Museum during the past summer.

In addition to the carvings on stone, the expedition obtained the well-known Didon necklace. This necklace is Aurignacian in age, and is composed of bone, stone and ivory beads from the Abri Blanchard in France. There are 143 beads, including an ivory fish pendant and four other pendants of bone. Each piece is carved from a bone or ivory baton and many are shaped like tiny baskets. They range in size from less than three millimeters in length to two or three centimeters. Each one has a hole drilled through each side with a tiny drill. The collection

contains over half of all the beads of this type and period so far discovered.

The other material collected this summer for the Logan Museum illustrates every type of European prehistory from the Eolithic to the Bronze Age, and was gathered in England, France, Switzerland and Denmark. It includes eoliths from the Harrisonian collection of East Anglia, early paleoliths from Dr. Balfour, of Oxford, and Dr. Lewis Clark, of Cambridge, also Cromer flints from Messrs. Maynard and Reid Moyre, of Ipswich. From France, Mousterian material was obtained from La Quina through Dr. Henri-Martin, from Haute Roche through L. Didon, also from Le Moustier, Le Placard and Le Miquoc. The Aurignacian flints came from Laussel, George d' Enfer and La Blanchard.

The Solutrean collection came from Laugerie Haute and La Placard. Neolithic and bronze material was obtained through the National Museum at Zurich, Switzerland, also Neolithic objects from Denmark, obtained through collectors, but passed upon by Inspector Kjor of the National Museum at Copenhagen, Denmark.

Magdalenian artifacts from Limeuil, La Madeleine and Laugerie Basse were secured through the efforts of Abbe Bouyssonie. Some very interesting objects, including an urn from a dolmen burial, were obtained from Tebessa, Algeria, through the kind offices of M. Reygasse, a governor in the province of Constantine, Algeria.

All who are interested in this collection are cordially invited to inspect it and to study not only the materials on exhibition, but those duplicates which are placed in storage, but which will be made accessible, at any time, to those who wish to study them

George L. Collie,
Curator

Logan Museum

THE PAN-AMERICAN CONFERENCE ON STANDARDIZATION

The Peruvian government has invited the twenty-one republics in the Pan-American Union to a conference on standardization to be held at Lima, Peru, beginning on December 23 of this year. The conference is called by the Pan-American Union at the request of the Fifth International Conference of American States which met at Santiago, Chile, in 1923. The Peruvian government will act as host.

Sixty technical and trade organizations in this country have been invited to send representatives and there will be representatives of similar organizations from other countries.

The general purpose of this conference will be to study the possibilities of developing inter-American and international standards for raw and finished materials as well as standardized classifications and nomenclature and to make recommendations with regard to the steps to be taken by the states looking toward the development of these objectives.

The Peruvian government has sought the cooperation of the Pan-American Union and the Inter-American High Commission in the development of plans and agenda, and these departments in turn have sought the advice of representative organizations and individuals. The preparatory work in questions relating to agricultural products and raw materials are being handled by the U. S. Departments of Commerce and Agriculture. The American Engineering Standards Committee has assumed an important part in preparing for the work among the manufacturing industries of this country and at the request of Director General Rowe has organized an advisory committee.

No attempt will be made to adopt actual standards at this meeting, but it is hoped that a substantial basis for inter-American standardization can be laid, first, through the development and encouragement of standardization work in the various states and, second, through the designation of some organization which will act as a central agency for the development of inter-American standardization. It is expected that plans will be made for a second conference within a couple of years.

The Peruvian government has not yet published the final agenda. The advisory committee to Director General Rowe of the Pan-American Union is, however, engaged in getting papers together for the conference. These will deal not only with the broad principles of standardization both national and international, but with practical economic conditions and there will be a number of papers of a popular nature dealing with particularly notable achievements in the field of standardization. Since the field of raw materials is more nearly ready for immediate cultivation and is of special interest to many of the American states, emphasis at this first conference will be laid upon this side of the undertaking.

THE FOURTH ANNUAL MEETING OF THE HIGHWAY RESEARCH BOARD

The Highway Research Board will hold its fourth annual meeting on December 4 and 5 in the new building of the National Research Council, Washington, D. C.

Mr. Thomas H. MacDonald, chief of the Bureau of Public Roads, will present a paper on the "Financial value of highway research as applied to road construction."

The various committees of the board will make their reports which will include the following subjects: The economic theory of highway improvements, structural design of roads, character and use of road

material, highway traffic analysis, highway finance, highway maintenance and also a report of the special investigation on reinforcement in concrete roads.

Research apparatus that has been successfully used in various experiments will be on display. This exhibit will not only include the apparatus used in laboratories, but will include also various loadometers, traffic counters and other instruments in use on the road.

On the evening of December 4, Mr. Herbert Hoover, secretary of the Department of Commerce, will speak at the highway research dinner.

This is the one meeting of the year where there is a rounded discussion of the practical application of highway research. Highway executives and engineers will find this meeting to be one of intense interest because of the correlation of research and practise.

THE CARNOT CENTENARY

THE one hundredth anniversary of the announcement by the French physicist and engineer, Nicholas Leonard Sadi Carnot, of the principle of thermodynamics, later known as the second law of thermodynamics and the Carnot cycle, will be celebrated by American engineering, physical and chemical societies and educational institutions of New York, at a meeting to be held under the auspices of the Engineering Foundation, on December 4 at 8:15 p. m., in the auditorium of the Engineering Societies Building.

The program will be as follows:

Dr. Wm. F. Durand, president-elect, American Society of Mechanical Engineers, will preside.

Addresses, Illustrated by Lantern:

Dr. Michael I. Pupin, professor of electromechanics of Columbia University; fellow of the American Institute of Electrical Engineers; member, American Physical Society, National Academy of Sciences and the National Advisory Committee for Aeronautics, will speak on "Carnot's principle."

Dr. William LeRoy Emmet, consulting engineer of the General Electric Company; member, American Institute of Electrical Engineers, Society of Naval Architects and Marine Engineers, National Academy of Sciences and the Naval Consulting Board, will speak on the "Application of Carnot's principle in engineering."

Cooperating Institutions and Societies:

American Society of Civil Engineers.
American Institute of Mining and Metallurgical Engineers.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.
Engineering Foundation.
American Physical Society.
American Chemical Society.
Columbia University.
New York University.
Stevens Institute of Technology.
College of the City of New York.
Polytechnic Institute of Brooklyn.
Pratt Institute.
Cooper Union for the Advancement of Science and Art

Committee of Arrangement:

American Society of Civil Engineers, George H. Pegram.

American Institute of Mining and Metallurgical Engineers, W. L. Saunders.

American Society of Mechanical Engineers, Joseph W. Roe.

American Institute of Electrical Engineers, L. W. W. Morrow.

Columbia University, George B. Pegram, Walter I. Slichter, Walter Rautenstrauch.

SCIENTIFIC NOTES AND NEWS

DR. THOMAS HUNT MORGAN, professor of zoology at Columbia University, has been awarded the Darwin medal of the Royal Society of London, for his work in zoology, and especially for research in heredity.

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, New York, was elected corresponding member of the Accademia Medico-Fisica Fiorentina at the centenary celebration of its founding in May, 1924. The French government has conferred on him the decoration of Chevalier de la Légion d'Honneur.

DR. ÉMILE ROUX and Dr. Louis Marten, of the Pasteur Institute; Professor Roger, dean of the faculty of medicine; Inspector-General H. Vincent, and Professors Achard, Carnot, Legueu and Widal, of Paris, have been elected honorary foreign members of the Academy of Medicine of Rome.

THE Alvarenga Prize of the College of Physicians of Philadelphia, for 1924, has been awarded to Dr. Gordon Cameron, Victoria, Australia. His subject was "Pancreatic anomalies; their morphology, pathology and clinical history."

A. V. VASSILIEV, formerly professor of mathematics at the Universities of Kazan and Petrograd, will celebrate in Moscow the fiftieth anniversary of his teaching activity on December 12.

PROFESSOR C. O. BATES, head of the department of chemistry at Coe College, is retiring under the Carnegie Foundation. He will continue his work as chemist for the city of Cedar Rapids, Iowa.

DR. E. J. LUND, associate professor of physiology in the University of Minnesota, has been named as an occupant of the American Association table at the Naples Zoological Station, for the period from December 10 to February 1 next.

DR. GEORGE E. BREWER has been nominated for the

presidency of the New York Academy of Medicine, in succession to Dr. George Stewart, whose term expires in December. Dr. Charles A. Elsberg and Dr. Frederick Van Buren were placed in nomination for vice-president.

DR. BENJAMIN T. BROOKS has been appointed chairman of a committee of the National Research Council to investigate the chemistry of petroleum.

PROFESSOR JAMES KENDALL, of the department of chemistry, Columbia University, has been reenrolled as a specialist in the United States Naval Reserve Force, with promotion to the rank of lieutenant-commander.

DR. J. V. HOFMAN, formerly director of the Wind River Forest Experiment Station, Washington, has accepted the position of assistant director of the Pennsylvania State Forest School at Montalto.

DR. A. T. LARSON and Dr. R. L. Dodge have left the Fixed Nitrogen Research Laboratory to take up work with the du Pont Company.

DR. W. A. ORTON has resigned as pathologist in charge of the office of cotton, truck and forage crop disease investigations in the U. S. Bureau of Plant Industry, to become scientific director and general manager of the Tropical Plant Research Foundation. Dr. Orton entered the service of the Department of Agriculture in 1899.

DR. H. FOSTER BAIN, director of the Bureau of Mines, will sail from the United States for Argentina on November 22 to make an extended study of the development of the steel and iron industry at the request of the Argentina government.

ON the occasion of the dedication of the Cornelia Clapp Laboratory at Mount Holyoke College, which took place in connection with the celebration of the eighty-seventh anniversary of the founding of the college, an address was given by Professor Edwin Grant Conklin on "Biology and human life." Dr. Clapp spoke of her fifty years teaching at the college and of the early days of the department of zoology of which she was the founder.

PROFESSOR CHARLES FABRY, director of the Institute of Optics, Paris, delivered an address on November 15, on "Thirty years work in spectroscopy with the interferometer" before a joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington.

DR. THORVALD MADSEN, director of the State Serum Institute of Denmark, will deliver the fourth Harvey Society lecture at the New York Academy of Medicine, on Saturday evening, November 22. His subject will be "Temperature and immuno-chemical reactions." The fifth Harvey Society lecture will be delivered by Dr. Willem Einthoven, professor of physiology in the Royal University of Leyden, Holland, on Saturday evening, December 6. His subject will be "The relationship of mechanical and electrical phenomena of muscular contraction with special reference to the cardiac muscle."

DR. OTTO WARBURG, of the Kaiser Wilhelm Institute of Biology, Berlin (Dahlen), has recently given two lectures before the scientific staff of the Rockefeller Institute for Medical Research, New York, "On the metabolism of carcinoma cells" and "Iron as an oxygen carrier of the respiration ferment." The lectures were followed by laboratory demonstrations of his methods of studying tissue respiration.

DR. HARRISON E. HOWE, editor of *Industrial and Engineering Chemistry*, gave a lecture at the Franklin Institute, on November 19, on "The trend and purpose of modern research."

THE seventh public lecture of a series on Physics in industry was on "Electrical precipitation," and was delivered by Sir Oliver Lodge on October 29, at the Institution of Electrical Engineers, London. The chair was taken by Sir Charles Parsons, president of the institute.

THE seventh public lecture of a series on physics was delivered on November 6, at the Finsbury Technical College, London, by Julian L. Baker, who spoke on "The chemist and the fermentation industries."

THE Thomas Hawksley lecture of the Institution of Mechanical Engineers, England, was delivered at the institution on November 7, by Vice-Admiral Sir George G. Goodwin. The subject was "The trend of development of marine propelling machinery."

THE Bradshaw Lecture of the Royal College of Surgeons of England on "Some clinical aspects of carcinoma of the breast" was delivered by Dr. Raymond Johnson on November 6, and the Thomas Vicary Lecture on "Sir Richard Owen as conservator" was given by Sir Arthur Keith, on November 12.

PROFESSOR H. B. DIXON, honorary professor of chemistry in the University of Manchester, delivered the inaugural lecture on "The life and work of Ludwig Mond" at the University of Manchester on October 20.

THE bronze bust of Dr. William H. Sanders, for many years professor in the department of medicine at the University of Alabama, has been given to the state of Alabama by the Alabama State Medical Association. It will be mounted at the entrance of the state health department building at Montgomery.

IN connection with the celebration of the centennial of the founding of the Medical College of South

Carolina, there was unveiled on November 12 a memorial tablet to Dr. Frank L. Parker, late professor of anatomy and dean of the medical college.

DR. THOMAS L. WATSON, Corcoran professor of geology at the University of Virginia and state geologist of Virginia, known for his contributions to mineralogy, petrology and economic geology, died on November 10 at the University of Virginia, aged fifty-three years.

NED HOLLISTER, superintendent of the National Zoological Park since 1916, a leading mammalogist, died on November 3, aged forty-eight years.

SIR ARCHIBALD GEIKIE, for many years director-general of the Geological Survey of the United Kingdom and former president of the Royal Society, the British Association for the Advancement of Science and the Geological Society of London, has died at the age of eighty-nine years.

DR. E. G. DEVILLE, director-general of surveys, Canada, died recently at the age of seventy-five years.

CHARLES FERGIE, ex-president of the Canadian Mining Institute, and a well-known mining engineer, died recently in his sixty-seventh year.

DR. J. E. CAMPBELL, F.R.S., lecturer in mathematics at the University of Oxford, has died, aged sixty-two years.

PROFESSOR DR. THEODOR KOCH-GRUNBERG, of the Ethnological Museum at Stuttgart, has died of malaria contracted while carrying on ethnological explorations in South America.

A DESIGN for a monument to Louis Pasteur has been submitted to the Pasteur memorial committee in Chicago by Leon Hermant, a French sculptor residing at the present time in Chicago. A sum of $100,000 is being raised with which to erect the memorial, and to endow a research scholarship that will be open to all American students. The monument design is a terraced fountain surmounted by a column which supports a bust of Pasteur. Clinging to the column are various supplicating human figures reaching up to receive healing from the great benefactor.

THE United States Civil Service Commission announces an examination for assistant scientist (apicultural physiologist), to fill a vacancy in the Bureau of Entomology, Department of Agriculture, Washington, D. C., at an entrance salary of $2,400. Receipt of applications closes on December 2. An examination is also announced for associate ordinance engineers with entrance salaries ranging from $3,000 to $3,600. Receipt of applications will close on December 16.

OFFICERS elected at the recent meeting of the Association of Official Agricultural Chemists were: Dr. C. A. Browne, chief of the Bureau of Chemistry, *president;* H. D. Haskins, Amherst, Mass., *vice-president;* Dr. W. W. Skinner, assistant chief of the Bureau of Chemistry, *secretary-treasurer.* The new members of the executive committee are Dr. W. W. Randall, of Baltimore, and Dr. W. H. MacIntire, of Knoxville. New members of the committee on recommendations of referees are H. A. Leppar, Dr. E. M. Bailey and Dr. A. G. McCall.

A SPECIAL joint meeting of the Helminthological Society of Washington and the Entomological Society of Washington was held on October 31, in the National Museum, Washington, D. C., in honor of Professor E. Brumpt, head of the laboratoire du parasitologie at the University of Paris. Dr. W. W. Cort, president of the Helminthological Society, acted as chairman, and Dr. C. W. Stiles, of the U. S. Public Health Service, introduced the guest of honor. Professor Brumpt outlined the organization of the laboratoire du parasitologie of the École de Médecine at Paris, which includes the following divisions: (a) mycology, (b) nematodes, (c) cestodes and trematodes, (d) protozoa, (e) insects, (f) culture of trypanosomes and other parasitic protozoa and (g) leeches, each section being assigned to a different worker. Professor Brumpt also touched upon investigations that are being conducted in his laboratory and emphasized especially the work on the transmission of trypanosomes of cold-blooded vertebrates by leeches, the rearing of ticks and other anthropod vectors of protozoan diseases, studies on strongyloides of various animals, and studies on anaplasmosis of cattle. Dr. L. O. Howard, chief of the Bureau of Entomology, made the closing remarks.

IT has been previously announced that the First International Congress of Mental Hygiene would be held in this country during the year 1925, if a fund adequate for the purpose could be secured by midsummer of 1924, since it would take a year at least to organize and arrange for the congress. Widespread interest in this project exists, but this interest has not yet expressed itself in the form of adequate financial support. In consequence, the holding of the congress must be postponed. The organizing committee in charge of the plan hopes to secure an adequate fund in time to hold the congress in 1926. Interest in the project continues to grow, as does the number of national leagues and committees for mental hygiene that will participate when the congress is held. Such societies have already been organized in Belgium, Brazil, Canada, Czecho-Slovakia, Denmark, France, Great Britain, Hungary, Italy, South Africa and the United States, and are in process of formation in Australia, China, Germany, Greece, Holland, Japan, Luxemburg, Norway, Sweden and Switzerland.

Cloudy conditions at Arequipa, Peru, during the months of December and March, preventing satisfactory observations, have led to the establishment of a new branch of the Harvard Observatory at San José, Peru, halfway between Arequipa and the Port of Mollendo. Dr. J. S. Paraskevopoulos, who is in charge of the Boyden Station at Arequipa, opened the temporary station of the new branch at San José, on November 1. The site selected is 4,850 feet above sea level, and has been chosen because at this elevation there has been found to prevail a nearly cloudless belt of sky even when at the same time Arequipa at its 8,000 feet of altitude is cloud-bound and Mollendo at its proximity to sea level is covered with low-hung clouds. Thus San José, set in the broad pampa between, on the other hand, gives promise of yielding excellent and dependable observing conditions. Dr. Paraskevopoulos will set up two telescopes at San José, a one-inch and a three-inch, both photographic telescopes, to be used in the Harvard Sky Patrol, which was begun in a systematic manner over forty years ago.

A contract has been awarded by the General Electric Company, Schenectady, for a five-story annex to the research and general engineering laboratory, costing approximately $550,000. The new building will be of reinforced concrete with brick veneer and will provide 115,000 square feet of floor space.

The *Journal of Medical Research,* official organ of the American Association of Pathologists and Bacteriologists, will change its name to the *American Journal of Pathology,* January, 1925. According to the *Journal* of the American Medical Association it has been given a subsidy of $7,500 a year for five years for the distinct purpose of helping pathology regain the prominence it formerly held as a fundamental branch of medicine, and to encourage young men of the best type to take up pathology as a career. The *American Journal of Pathology* will be published under the management of the present editorial board and will appear bimonthly. It will be restricted to pathology, especially the morphologic side.

Columbia University and the insular government of Porto Rico have established a school of tropical medicine at San Juan, Porto Rico, under the administration of Columbia University. According to the *Journal* of the American Medical Association the school was opened on September 25. Pending the reorganization of the Institute of Tropical Medicine and the erection of a laboratory building in San Juan, the courses in the fundamental biologic and chemical subjects will be given at Columbia University, New York. The courses in clinical medicine and surgery, preventive medicine, public health and sanitation, beginning on January 5, will be given in Porto Rico by members of the Institute of Tropical Medicine, the department of health, the Presbyterian Hospital of San Juan, and by members of the hookworm and malaria stations of the International Health Board. The courses will include laboratory work, clinical teaching and the demonstration of sanatorium machinery in action. Clinical material will be available at the Municipal Hospital of San Juan, which has set apart two wards for the exclusive use of the school; at the Presbyterian Hospital of San Juan, with a capacity of seventy-five beds and an active dispensary service of about 4,000 cases a month; and at the various special hospitals and dispensaries of the department of health which is actively cooperating in the project. The last month of the course will be given over to a medical expedition into the mountains of Porto Rico. The course is open to qualified graduates in medicine and will cover a period of eight months. The cost of living at San Juan will range from $100 to 150 a month. Registration will be limited to twenty students. Inquiries should be addressed to the dean of the Columbia University School of Medicine.

According to *Nature,* a survey of the Great Barrier Reef area has been undertaken by the Commonwealth Government of Australia, and the naval sloop *Geranium* has been detailed for the work. The vessel will have a seaplane attached for general help and work in the survey, and a preliminary flight around the coastline of Australia was recently completed with the view of deciding the kind of assistance which can best be afforded from observations in the air. The commander of the *Geranium* is a member of the Barrier Reef Committee of the University of Queensland, and he will take with him two scientific investigators attached to the committee.

The Fremont Forest Experiment Station, which was established by the United States Department of Agriculture at Colorado Springs, Colorado, is celebrating its fiftieth anniversary this year. The second of its kind in the western forest regions of the country, it has for a number of years been conducting experiments with trees similar to those made with agricultural crops and garden plants at agricultural experiment stations. The field depot of the station is on Mount Manitou. Besides these laboratory experiments, a considerable part of the work of the station is distributed over the national forests of Colorado, Wyoming, South Dakota and Nebraska, where field tests are made and permanent plots established to determine the best reforestation practices, the rate of

growth of stands, the best methods for thinning stands and for obtaining natural regeneration of forests. In some localities the relation of grazing to forest regeneration is receiving attention.

UNIVERSITY AND EDUCATIONAL NOTES

The estate of the late J. Stephen Tripp, amounting to some $550,000, "to be used as the regents see fit," has come into the hands of the University of Wisconsin, as a result of the death of the last beneficiary.

Fire at Earlham College has destroyed the administration building and part of the museum. The damage done is estimated to be $250,000, in addition to the loss of many scientific records.

The Ramsay Laboratory of Chemical Engineering at University College, London, was opened on November 12.

Professor Guido H. Marx this year succeeds Professor William F. Durand, retired, as head of the department of mechanical engineering at Stanford University.

Dr. William Pinkerton Ott, associate professor of mathematics at Vanderbilt University, has been appointed head of the department of mathematics at the University of Alabama.

Dr. P. M. Ginnings has resigned as professor of chemistry at Centenary College of Louisiana, to become professor of chemistry at North Carolina College for Women. His place at Centenary College will be taken by Dr. Albert Salathe, professor of chemistry at Sweet Briar College, Virginia.

Dr. Carl Arthur Hedblom, of the Mayo Clinic, Rochester, Minn., has been appointed chief surgeon of the Wisconsin General Hospital, and professor of surgery at the University of Wisconsin Medical School, Madison.

L. P. McCann has been appointed associate professor of animal husbandry at Colorado Agricultural College to succeed Professor B. W. Fairbanks.

Dr. Earl D. MacPhee, of the University of Alberta, has accepted an appointment in the department of psychology at the University of Toronto.

Professor Lucatello, of Padua, has been nominated successor of Professor Maragliano in the chair of internal medicine at Genoa.

Professor Andrew Robertson, professor of mechanical engineering in Bristol University, has been appointed principal of Bristol Merchant Venturers Technical College, in succession to the late Dr. Wertheimer.

DISCUSSION AND CORRESPONDENCE

THE QUANTUM NUMBERS OF THE BOHR ORBITS IN THE ALKALI ATOMS

In a recent article, Dr. L. A. Turner[1] proposes a change in the assignment of quantum numbers to the orbits in certain atoms, as given by Bohr in his latest theory.[2] This applies particularly in the principal quantum numbers assigned to the outermost orbits in the heavier alkali atoms and alkaline earth ions. The essential features of the proposed change may be indicated briefly in the following table:

Element	N	n^*	n_B	n_T	q_B	q_T
Li	3	1.59	2	2	.41	.41
Na	11	1.63	3	3	1.37	1.37
K	19	1.77	4	4	2.23	2.23
Rb	37	1.81	5	6	3.19	4.19
Cs	55	1.87	6	8	4.13	6.13

In the above table, N denotes the atomic number, n^* the effective quantum number of the outermost orbit in the atom, n_B the corresponding principal quantum number as assigned by Bohr, n_T, the same as assigned by Turner, while q_B and q_T are the corresponding quantum defects (differences between n^* and n) on the two points of view, respectively. It will be seen that Turner proposes to increase Bohr's principal quantum numbers for the orbits in Rb and Cs by *one* and *two*, respectively. His reason for this step is based on an examination of the variation of the quantum defect with N. For he finds that if we plot q as a function of N, using the Bohr values, we get a broken line with the break occurring at K (as will be seen from an inspection of the table), while if we plot q as a function of N, using Turner's values, we get a very nearly straight line. (It must here be remarked that this also applies to the corresponding case in the ionized alkaline earths and certain other atoms). No theoretical reason can apparently be assigned to the straightness of this line. The present writer wishes to examine available evidence as to the justification of Turner's new assignment.

Numerical calculations have been carried out by the writer[3] for the dimensions of the orbits in the Bohr models of the alkali atoms. These show conclusively that Bohr's assignment of the quantum numbers for the outermost orbits is the only one which yields the correct values of the effective quantum numbers, provided, of course, that the *inner* groups of orbits remain as assigned in the Bohr theory. In fact, a short calculation on the basis of the results there obtained indicates that the assumption of $n = 6$ in-

1 L. A. Turner, *Phil. Mag.*, Sept., 1924.

2 See particularly N. Bohr, *Ann. d. Phys.*, 71, 228, 1923.

3 Proc. Amer. Phys. Soc. 23, 552 (A8) 1924. For complete details of calculations see *Jour. of Math. and Phys.*, Mass. Inst. Tech. III, 191, 1924 (May).

stead of n = 5 in the case of Rb will lead to a value of $n^* = 2.80$, approximately, while the choice of n = 8 for Cs will yield $n^* = 3.80$, approximately.

It thus appears that Turner's assignment, if true, will necessitate a complete rearrangement of the inner quantum groups—a very serious step and one open to much criticism in the opinion of the present writer. One significant point may be mentioned here. The writer found in the calculations above mentioned that the computed values of the dimensions of the outermost orbits in the ionized alkali atoms (a measure of the ionic radii) obey the Grimm inequality law,[4] *viz.,*

$$R_K - R_{NS} > R_{Cs} - R_{Rb} > R_{Rb} - R_K$$

where R_{Na}, R_K, etc., refer to the radii of the ions of sodium, potassium, etc. This law appears to be an extremely fundamental one in connection with atomic characteristics in general. (It is interesting to note that it is followed, as might be expected, by the effective quantum numbers themselves). A rearrangement of the inner groups of orbits in Rb and Cs would vitiate this result, and lead to values for the dimensions of these ions which are much too large in comparison with the dimensions of the lighter alkalies.

In the opinion of the writer it is therefore apparent that Turner's assumption, while leading to an interesting result, can hardly be maintained.

A thorough study of the quantum defect may be expected to be of great value in the development of the Bohr theory, particularly in connection with the analysis of the spectral terms of multiply-ionized atoms. Certain simple relations relevant hereto and admitting of simple interpretation on the Bohr theory are in process of derivation and arrangement by the writer and will be published shortly.

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WHITE INDIANS OF DARIEN

Lionel Wafer, a ship's doctor and an associate of Dampier's, has left us an interesting account of the White Indians of the Isthmus of Darien. Wafer fell into the hands of the Darien Indians on the 5th of May, 1681. These were copper-colored natives of the coast, but while a captive among them he had frequent opportunities to observe other Indians of a different complexion. He has this to say about the White Indians:[1]

There is one Complexion so singular, among a sort of People of this Country, that I never saw nor heard of any like them in any part of the World. The Account will seem strange, but any Privateers who have gone over the Isthmus must have seen them, and can attest the main of what I am going to relate; tho' few have had the opportunity of so particular an Information about these People as I have had.

They are White, and there are of them of both Sexes; yet there are but few of them in comparison of the Copper-colour'd, possibly but one to two or three hundred. They differ from the other Indians chiefly in respect of Colour, tho' not in that only. Their Skins are not of such a White as those of fair People among Europeans, with some tincture of a Blush or Sanguine Complexion; neither yet is their Complexion like that of our paler People, but 'tis rather a Milk-white, lighter than the Colour of any Europeans, and much like that of a White Horse.

For there is this further remarkable in them, that their Bodies are beset all over, more or less, with a fine short Milk-white Down, which adds to the whiteness of their Skins: For they are not so thick set with this Down, especially on the Cheeks and Forehead, but that the Skin appears distinct from it. The Men would Probably have white Bristles for Beards, did they not prevent them by their Custom of plucking the young Beard up by the Roots continually: But for the Down all over their Bodies, they never try to get rid of it. Their Eye-brows are Milk-white also, and so is the Hair of their Heads, and very fine withal, about the length of six or eight Inches, and inclining to a Curl.

They are not so big as the other Indians; and what is yet more strange, their Eye-lids bend and open in an oblong Figure, pointing downward at the Corners, and forming an Arch or Figure of a Crescent with the Points downwards. From hence, and from their seeing so clear as they do in a Moon-shiny night, we us'd to call them Moon-ey'd. For they see not very well in the Sun, poring in the clearest Day; their Eyes being but weak, and running with Water if the Sun shine towards them; so that in the Day-time they care not to go abroad, unless it be a cloudy dark Day. Besides they are but a weak People in comparison of the other, and not very fit for Hunting or other laborious Exercise, nor do they delight in any such. But notwithstanding their being thus sluggish and dull and restive in the Day-time, yet when Moon-shiny nights come, they are all Life and Activity, running abroad, and into the Woods, skipping about like Wild-Bucks; and running as fast by Moon-light, even in the Gloom and Shade of the Woods, as the other Indians by Day, being as nimble as they, tho' not so strong and lusty.

The Copper-colour'd Indians seem not to respect these so much as those of their own Complexion, looking on them as somewhat monstrous. They are not a distinct Race by themselves, but now and then one is bred of a Copper-coloured Father and Mother; and I have seen a Child of less than a Year old of this sort. Some would

[4] H. Grimm, *Zs. f. Phys. Chem.*, 5, 353, 1921.

[1] "A New Voyage and Description of the Isthmus of America," by Lionel Wafer (Reprinted from the original edition of 1699) Cleveland, The Burrows Brothers Company, 1903.

be apt to suspect they might be the Off-spring of some European Father: But besides that the Europeans come little here, and have little Commerce with the Indian-women when they do come, these white People are as different from the Europeans in some respects, as from the Copper-colour'd Indians in others. And besides, where an European lies with an Indian-woman, the Child is always a Mostesa, or Tawney, as is well known to all who have been in the West-Indies; where there are Mostesa's, Mulatto's Etc. of several Gradations between the White, and the Black or Copper-colour'd, according as the Parents are; even to Decompounds, as a Mulatto-Fina, the Child of a Mulatto-man, and Mostesa-woman, Etc.

But neither is the Child of a Man and Woman of these white Indians, white like the Parents, but Copper-colour'd as their Parents were. For so Lacenta (an Indian chief) told me, and gave me this as his Conjecture how these came to be White, That 'twas through the force of the Mother's Imagination, looking on the Moon at the time of Conception; but this I leave others to judge of. He told me withal, that they were but short-liv'd.

CLARENCE QUINAN

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AGE OF SHAD ESTIMATED FROM EXAMINATION OF SCALES

AN estimation of the age of fish by counting the number of annular rings on the scales has been possible in the case of numerous species. For the shad (*Alosa sapidissima,* Wilson), however, this appears not to have been done up to the present time; although considerable success has been attained in age estimation of certain *Clupeidae* other than shad, for example, the herring.

The investigation, authorized by the Connecticut State Legislature and undertaken by the Board of Fisheries and Game for the purpose of discovering the cause and cure of the decline of Connecticut River shad, necessitated an extension of the meager existing knowledge of shad migrations. Age determinations were required for this phase of the work.

The annular rings (annuli) of the shad scale are rather difficult to see and to differentiate from other circular markings on the scale. I have therefore undertaken a systematic study of the scales from shad of various sizes, studying all the scale markings. Preliminary experience with staining and other methods of preparation to bring out the annular markings gave unsatisfactory results. It therefore appeared necessary to make use of other markings. Of these, the transverse grooves running completely across the scale were found to have a constant relation to the annuli in those scales in which the latter were sufficiently distinct to be counted. The relation is: two *complete* grooves (omitting incomplete ones) to one annulus. In young shad of known age, less than one year, there are one or two complete transverse grooves on the scale. Although annuli should be counted when possible, the counting of the grooves gives supplementary information and may even be relied upon when the annuli are not distinguishable. The number of the complete grooves divided by two gives the age of the shad in years.

Age determinations by this method have been confirmed by examination of the otoliths of shad. Mr. R. L. Barney, who has made these examinations, finds that the size and markings of the otoliths give age estimations which agree with the scale readings.

The scales selected for observation should be of regular shape and should show no distortion of scale markings such as apparently result from the effects of external injuries. I have used scales from the anterior part of the body at a point about half way between lateral line and pectoral fin.

Examination of shad ascending the Connecticut River during the present season shows that males are of ages four, five, six, seven and eight years, females, seven, eight, nine and ten years. Adult shad of both sexes of sizes less than 32 cm in length occur, as a rule, only in the sea.

This report is preliminary. A more extended account with drawings and microphotographs of the scales and with tabulated data will be published later.

N. BORODIN

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THE FRESH-WATER JELLYFISH (CRASPEDACUSTA SOWERBYI) IN KENTUCKY AGAIN

THIS fresh-water medusa, for many years regarded as a rarity by zoologists, appears to have become permanently established in Kentucky. In 1916 and 1917[1] it was found by the writer in great numbers in Benson Creek, but in subsequent seasons (of 1918 to 1923, inclusive) it was not found and thus seemed to have remained true to its history of infrequent appearances at widely separated points on the globe. But a visit made September 5, 1924, to the spot where it was discovered in 1916 showed it to be still there. Many were collected; hundreds could have been obtained. On the twelfth of this month a second visit to the locality showed it less common at the surface of the water, but in several hours spent in the search it was learned that it had retreated to a depth of several feet and could be brought up in some numbers by stirring the water with the oars of a rowboat. Its movements are stimulated by sunlight, and as the day was cloudy but few were attracted toward the

[1] SCIENCE, Vol. XLIV, 1916, p. 858; Vol. LVI, n. s., 1922, p. 664.

surface and within reach of my dip-net, though a good many were brought up by use of the oars. This habit of retreating from the surface when weather conditions are unfavorable explains the apparent absence of the medusae on some of my previous visits to the creek. It has become evident that cloudy weather is unfavorable to finding it. The best conditions, judging by the character of the three seasons when it has now been found, are settled, clear days, when the water is low, free from silt and there is little current in the creek.

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THE PEANUT PLANT

Since the peanut plant (*Arachis hypogea* L.) has become of such economic importance as to demand a description in every text-book on field crops, attention should be called to a mistake that was made by the early writers so that in the future the blossoms of this important plant might be correctly described.

Arachis hypogea is one of the Leguminosae and has sessile papilionaceous blossoms. The calyx consists of a tube about an inch in length crowned by the five sepal tips. On the throat of calyx tube are situated the five bright yellow petals. The calyx tube was mistaken for a peduncle and so described by the early authors, and the whole structure was termed a "sterile" blossom. After the blossom withers and falls off, the ovary, by the rapid growth of the internode between it and the receptacle, is lifted from between the bracteoles in the leaf axil and responding to geotropic influence turns toward the earth and the seeds are further developed and ripened only after it has been pushed below the surface of the ground. The early writers looked upon and described this gynophore with its ovary as a "cleistogamous" blossom.

Poiteau in 1805 first correctly described the blossom of the peanut. Robert Brown in 1816 confirmed Poiteau's description. In 1839 Bentham wrote of *Arachis hypogea* as a plant with dimorphic flowers, one with calyx and corolla which is always sterile, the fertile flowers having "neither calyx, corolla nor stamens . . ." and when Neisler in 1865 reconfirmed Poiteau's description, Bentham in the same year defended his paper of 1839. Corbett as a contributor to the "Cyclopedia of American Agriculture" (1907) describes the plant as having dimorphic flowers and *illustrates* the "fertile" and "sterile" blossoms.

Notwithstanding the works of Poiteau, Brown and Neisler, the majority of our modern publications, including scientific papers, agricultural bulletins and text-books on farm crops, in referring to the peanut plant seem to quote from the earlier writers and speak of it as having fertile and sterile blossoms, whereas it has complete blossoms and is self-fertilized.

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SCIENTIFIC BOOKS

Neurological Foundations of Animal Behavior. By C. J. Herrick, H. Holt & Co., New York, January, 1924, xii + 324 pp.

Physiological Foundations of Behavior. By C. M. Child, H. Holt & Co., New York, January, 1924, xii + 330 pp.

The "Neurological Foundations of Behavior," by C. J. Herrick, and the "Physiological Foundations of Behavior," by C. M. Child, were written in close collaboration and were issued from the press at the same time. They represent, so to speak, twin volumes; they appear, as twins commonly do, in the same garb, and they are of nearly the same size. But in addition to these superficial features of likeness, there are many other points of resemblance due to common hereditary factors. The writers appear to be in essential agreement in regard to their fundamental concepts. The notion of metabolic gradients which Child has elaborated in several volumes and a multitude of papers is adopted also by Herrick, and it forms the keynote of both volumes. The gradient idea, according to the authors, gives not only an interpretation of organic form, but it affords the basis for a science of behavior.

Both authors regard form and behavior as intimately and essentially correlated. It is the structure and physiological properties of the nervous system that form the neurological foundations of behavior, and Herrick's volume is devoted largely to describing the various types of nervous organization in different groups of animals, and in showing the significance of these types in relation to the kinds of behavior which the animals exhibit. After Herrick's first two chapters, which are mainly introductory, there is a description, in chapters 3 and 4, of the different types of receptors. Then follows in chapters 5 to 16 a survey of the types of nervous systems with their correlated kinds of activity from the protozoa to the higher vertebrates. For the reader who wishes to obtain a comprehensive idea of the architecture and evolution of the nervous system, these chapters will prove most useful. Throughout the volume, structure is interpreted from the standpoint of function. To show how the mechanism works is the constant aim.

For many readers, perhaps the most interesting of the series of chapters mentioned are those dealing with the "Evolution of the forebrain and functional factors in forebrain development." The forebrain is

the seat of intelligence in vertebrate animals, and a peculiar interest attaches to the study of its evolution. "Within the forebrain of higher vertebrates, and especially the cerebral cortex," says Herrick, "there are correlation and association centers of very different type, centers which are not dominated by any single sensorimotor system but are reached by fiber tracts from several lower sensory centers. Here the more difficult problems of conduct are solved; these are deliberative reactions, the occasion for which arises only when the innate instinctive and reflex modes of response prove inadequate to make the required adjustment."

How is this higher type of correlation brought about? What is the structural mechanism that underlies it? What is the basis of the modifiability of behavior, and especially how is behavior coordinated so as to secure the welfare of the organism? These are some of the questions which Herrick discusses in the following chapters. With Herrick, as with Child, the conception of dominance plays an important part in the interpretation of coordinated behavior. The nervous system is a dominating system, and the higher centers, at least for certain kinds of activity, dominate the lower ones.

> The higher brain centers, including the cerebral cortex of man and many of the subcortical correlation centers, do not replace the lower reflex centers, but on the other hand the only way into these higher centers is through the lower [see Herrick, 1913, and 1922, chap. 21]. Physiologically, this implies that the lower reflexes and instinctive reactions, which employ the direct passageways through the central nervous system, will always do the work when their stereotyped mechanisms are adequate to resolve any given stimulus complex into the appropriate and satisfying reaction. These lower centers are always first activated, but if they fail to solve the problem of conduct satisfactorily the flow of nervous energy will be dammed up in them and finding no appropriate outlet directly into the motor organs it will then be diverted upward into the higher correlation centers. Once these higher centers are activated, their own intrinsic processes liberate a large amount of latent metabolic energy of the very special type already described, resulting in a local summation or intensification of the excitation process.

When difficult problems have to be dealt with the lower centers pass the problem up to the higher ones, activating the latter with an intensified energy and making them thereby "the organs of highest physiological dominance of the entire body."

In the last chapter on "Progressive factors in evolution," Professor Herrick, who exhibits throughout the volume a keen appreciation of the broader aspects of his theme, permits himself the luxury of philosophizing a bit on a number of topics which lie near the borderland of neurology. Among these topics is a discussion of critical stages in progressive evolution, the uniformity and essential similarity of vital processes from Amœba to man, habit formation in education, creative intelligence, behavior in relation to consciousness, and finally the future of human evolution. On these as well as on many other suggestive discussions, limits of space forbid further comment.

The volume of Dr. Child consists of an elaboration of the gradient concept with especial reference to behavior. In all organisms there are, according to Child, gradations in the intensity of metabolic processes which determine the fundamental outlines of axial symmetry and structural differentiation. The existence of these gradients has been demonstrated in a great variety of organisms and by several different methods. Gradations of metabolic rate are indicated by differences in the rapidity of oxidation and the elimination of carbon-dioxide, differential susceptibility to poisons, and changes in electrical potential. Centers of high metabolism tend to dominate or control centers of low metabolism, excitation being conducted from the one to the other and thus forming the mechanism of the control which is exercised by the dominant center. In the regeneration of a hydroid from a piece of the stem the oral end of the piece usually exhibits the highest metabolism and therefore develops into the head. The head dominates and determines the way in which the part lying just below it develops, and the latter dominates the next region, etc., until the stem is shaped into a new hydroid with duly subordinated parts.

There is no doubt that these metabolic gradients exist. They are shown by the stems of hydroids, the bodies of planarian and annelid worms, the long axis of vertebrate embryos and the growing stems of plants. In one way or another, they probably occur in all organisms. According to Child, they constitute if not the chief, at least fundamentally important directive agencies in development and regeneration. There can be no doubt that they commonly accompany differentiation. Are they to be regarded as the cause of differentiation or its effect, or are both perhaps the result of some common underlying cause? Child believes that these gradients are actual causes of differentiation. In support of his view he cites many cases in which gradients may be reversed or new gradients established by environmental agencies which change the rates of metabolism in different parts of the organism. Even the major axes of plants and animals may be determined by external factors if the latter begin to operate sufficiently early.

Child has little sympathy with preformational theories of development. The production and main-

tenance of organic form is a dynamic process. Development is not a process of building in which materials first get arranged somehow and begin to function afterward. It is a process of physiological functioning, or we may say behavior, at all stages. The progress of experimental morphology has given the death blow to the older theories of both nuclear and cytoplasmic organization as a basis for development. Often there is, it is true, a visible organization of the substances of the egg, but it is also true that it has no very fundamental significance for ontogeny. It is the product of development and not its antecedent. Child is probably right in his contention that the theory of formative stuffs, which Loeb has taken over from Sachs, has little real explanatory value. He is probably also right in rejecting the various theories which would explain form production as akin to crystallization. Development he regards as a process of physiological regulation in which the differentiation of organic form is the outcome of organic adjustment. The thing that makes for order, in his view, is the relation of dominance and subordination involved in the establishment of gradients.

It has always been a troublesome problem for the epigenesist to supply a real explanation of the order and harmony manifested during development, and it is a noteworthy circumstance that the great protagonist of this doctrine, C. F. Wolff, felt himself compelled to postulate a *vis essentialis* as a guiding principle to keep things in order. Gradients are supposed to function as unifying agencies which introduce a certain system of correlation on account of the relations of dominance and subordination which they involve. Hence they form an alluring notion to an epigenesist who is seeking for a dynamic interpretation of the orderly wholeness of the organism in the various stages of its history.

Apparently a gradient is a very simple thing, at least at first. It is merely a decreasing series of metabolic changes which differ primarily in purely quantitative aspects. But quantitative changes, as Child plausibly argues, may cause qualitative differences, and the latter may in turn occasion further differentiations, the precise way in which the process of complication is carried out being conditioned by the initial constitution of the protoplasm which is transmitted by heredity. A simple gradient may be passed on through the polarity of the egg, but this axis is not important. It may be determined by environment. But once the gradient is set up, it does not matter much where or how, the rest of development follows.

We must refer the reader to the original volume if he would gain an idea of Child's application of the gradient concept to the problems of physiological integration, regeneration, budding, the functioning of the nervous system and the coordination of behavior. The notion of gradients has been the dominating concept in most of Child's numerous researches for several years. How far it will take us towards a causal explanation of the phenomena of organic regulation remains to be seen. The dominance and subordination brought about by pace-making centers is essentially a one-sided relation. It represents an autocratic type of control. It is analogous to the control of an army in which the general issues orders to the superior officers who transmit them to officers of lower rank, from whom they finally come down to the common soldiers. Is this the kind of government that goes on in an organism, or are the relations throughout those of a thoroughgoing reciprocality? Is the organism governed from a dominant center like a monarchy, or like a democracy with plenty of initiative and referendum? These are important questions in regard to Child's general viewpoint. If development and regeneration involve a thoroughgoing mutual adjustment of developing parts, the establishment of gradients can apparently do little more than provide for the localization of formative processes (to use a favorite expression of Driesch) without supplying the fundamental principle underlying the production of organic form.

In the last two chapters Child extends the gradient concept to the organization of society. "Leadership, dominance, the pacemaker play the same rôle in social as in physiological intergration." The center of high metabolism has its analogue in the social leader, or it may be in the "dominance of ideas." The similarities which exist between society and the organism largely grow out of the fundamental likenesses of their component units. And societies are essentially democratic whatever may be their form of political government. Even in the most arbitrary of despotisms rulers do not rule their subjects nearly so much as the subjects rule their rulers. Societies are everywhere founded on a give and take relationship; they are always mutual benefit organizations. If the analogy betwen social and physiological integration is to be taken seriously, as I believe it must, it would lead us to infer that the unity of the physiological organism is the result not so much of a one-sided relation of dominance and control as a thorough, mutual determination. I can not feel that Child's incursion into social science has strengthened his case. Rather, it has served to reveal more clearly a fundamental shortcoming of his theory of organic wholeness. It is not denied that the gradient relation may be one of fundamental importance in the establishment of organic axes and the localization of morphogenetic processes. But the gradient theory

suffers from much the same kind of inadequacy as the theory that social organization is the result of a hierarchy of dominant functionaries who derive their authority from a common ruler. It really matters little whether the dominant influences are conceived to be persons or ideas.

There are many features of Child's and Herrick's volumes which can not be considered in a brief review. Both books are substantial contributions from workers who have spent years of research and reflection in the fields which are covered. The biologist, whatever may be his specialty, may gain from them many new facts and stimulating ideas.

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SPECIAL ARTICLES

ENZYMES OF THERMAL ALGAE

The algae of the hot springs in Yellowstone National Park offer good opportunity for a study of the distribution of enzymes in relation to the temperatures at which the organisms live. There is a complete series of thermal springs ranging in temperature from the boiling point (about 91° C) down to ordinary temperatures. Algae are found growing at a great many different temperatures within this range. One species of Phormidium was found growing at 89° C in Beryl Spring.

The action of some enzymes has been shown to be destroyed at temperatures much below the normal temperature range of some of these thermal algae. It seems of interest to determine at what range of temperature the thermolabile enzymes are present in the algae, and how the algae are able to conduct their metabolic processes at temperatures above the maximum for the activity of several important enzymes.

Phormidium laminosum was found growing in pure culture in Hymen Terrace spring at 73° C. to 65° C. Its range did not extend below 65° C. Possibly other factors than the temperature were concerned in this distribution, since the carbon dioxide and hydrogen sulfide used by this organism are quickly liberated from the water after it escapes. Possibly the temperatures below this range do not allow metabolic processes to proceed normally in the absence of certain enzymes.

Determinations on the catalase, oxidase, oxydo-reductase and peroxidase action of this Phormidium were made immediately at the spring. For oxydo-reductase activity the reduction of methylene blue in the presence of acetone was used. Strong reduction was shown by the preparation, some of which was probably due to the reducing substances present in the water which can not be eliminated. For oxidase activity, the oxidation of tetra methyl para phenylene diamine showed a slight activity. On the addition of hydrogen peroxide to this reagent a very active peroxidase action was shown. Catalase was determined by means of the Van Slyke apparatus commonly used for the determination of amino acids, the oxygen being liberated in the reaction vessel and measured in the burette. The material was collected from pure culture and the determinations were completed within a few minutes. No catalase activity was shown by the Phormidium filaments either suspended in water or after grinding for a long time in a mortar with fine quartz sand and calcium carbonate. The failure to decompose hydrogen peroxide was not due to any defect in the experiment or to poisonous substances in the spring water, since leaves of Iva xanthifolia treated in exactly the same manner with spring water showed high catalase activity at room temperature. It must be concluded, then, that this Phormidium possesses no catalase and little oxidase activity but shows a strong peroxidase and probably oxydo-reductase action.

Catalase previously has been found to be of universal distribution in living organisms. Czapek in his "Biochemie der Pflanzen" gives a bibliography of its distribution in various groups of plants and animals. Oscar Loew concluded that catalase was universally distributed, occurring in every organism and necessary in every living cell. This is the first instance of its absence from an organism having been demonstrated. G. B. Reed reported catalase activity in ripe and half ripe pineapples but found no activity in very green pineapples. No mention was made of controlling the acidity, so it seems probable that the catalase present in the green fruits was destroyed in the preparation. This enzyme, therefore, can not be required for the life activities of all organisms as has been suggested. The maximum temperature for the activity of catalase is low. Catalase derived from leaves of Iva xanthifolia was destroyed at the temperature of the spring water of Hymen Terrace (73° C.) by exposure for less than one minute. Oxydo-reductase is known to have a rather high optimum (57° C.) for its activity, and peroxidase activity is shown at the boiling temperature since it is thermostable, in fact, to such a degree that there is doubt that it should be included in the class of enzymes.

The fact that an organism can live at the temperature at which water boils at high altitudes demands that by some means it shall be able to carry on the hydrolytic cleavages or other chemical activities required for its metabolism. As the altitude increases there would be found a level at which water would maintain a constant temperature by boiling at a tem-

perature at which some members of the genus Phormidium live normally. This altitude would not be much higher than the present plateau of Yellowstone Park. The fact that amino acids and a great many substances found in living organisms can be synthesized without the intervention of organisms by the ultra-violet radiations existing at such altitudes is suggestive of the probable place of origin of life forms. If such complex substances should be formed under present conditions, they would be quickly used by the omnipresent organisms capable of using them. Before the appearance of any living organism there would be possible the accumulation of such substances in quantity, a condition which is not realized under existing conditions. The action of hydrolytic enzymes in thermal algae might be substituted by the purely physical condition of high temperature on account of the increase in the rate of chemical reactions with increase in temperature according to the Van't Hoff coefficient. If high temperature can substitute the action of hydrolytic or other enzymes in these thermal algae, this may give a clue regarding the environmental conditions obtaining at the time of the origin of living things, since at high temperatures no such enzymes might be required. It is difficult to conceive of an organism originating with a full complement of enzymes, photosynthetic pigments, etc. Absence of certain important enzymes from an organism may well indicate a primitive type of physiological processes in which the organism makes use of physical conditions of the environment to substitute the action of complex biological catalysts. Since these thermal algae are able to carry on their life processes without catalase, which is found in all other organisms, and since they possess certain thermostable catalysts, with the additional use of high temperature to speed up other chemical reactions which are commonly catalyzed in other organisms by special enzymes, they seem particularly adapted to growth at high temperatures. Certain of the enzymes may have become necessary only in the evolution of forms adapted to lower temperature. The chemosynthetic forms of the iron and sulfur bacteria have been considered for several reasons to closely approach the type of physiological processes demanded for a primitive organism. They are able to fix atmospheric nitrogen, and they synthesize their carbon compounds without the intervention of photocatalytic pigments using the oxidation of inorganic material such as H_2S as the source of energy for synthesis.

The algae of these springs offer opportunity for the solution of some physiological questions of fundamental importance. Owing to the lack of facilities for laboratory work in Yellowstone Park at the time, determinations of other enzymes was delayed until they might be made upon material preserved with toluol and with 85 per cent. ethyl alcohol. Report upon the occurrence of other enzymes in these algae will be made by Miss Olga Lakela, who has completed the work.

R. B. Harvey

University of Minnesota

THE PRODUCTION OF HYDROGEN SULFIDE BY YEAST

The production of hydrogen sulfide by living yeast cells in the presence of sulfur or certain sulfur derivatives is well known in the literature. The work of de Rey-Pailhade[1] showed that yeast extracts were also able to produce hydrogen sulfide in the presence of sulfur. He attributed the formation of hydrogen sulfide to the presence of a substance in the yeast which he termed "philothion." The recent work of Hopkins,[2] however, appears to indicate that de Rey-Pailhade's "philothion" is similar to a dipeptide of glutamic acid and cystein which Hopkins isolated from yeast and animal cells. This compound after oxidation is easily reduced and also forms hydrogen sulfide when shaken with sulfur.

The presence of an active reducing enzyme in yeast has been demonstrated by Hahn[3] and others, so that very probably the reducing properties of yeast are largely due to enzyme activity of this nature.

The production of hydrogen sulfide by yeast, apart from its purely biochemical interest, is of considerable practical importance. Examples of hydrogen sulfide production are well known in the fermentation industries. Wine and beer stored in casks which have been fumigated with sulfur will often develop hydrogen sulfide, and such effects have been explained by the reducing activity of yeast in the presence of free sulfur, sulfites, and loosely bound sulfur compounds of a protein nature.

In flour and baking, however, the production of hydrogen sulfide by yeast in dough seems to have received little or no attention, and the writer has been unable to find any information or reference to this phenomenon in the literature thus far examined.

Recently the production of hydrogen sulfide by yeast in this connection was brought to the writer's attention. The flour was a northern spring patent, of normal appearance, odor and taste. It was capable of producing a fairly good bread, but on fermentation gave off the odor of hydrogen sulfide. An

[1] Rey-Pailhade, J. de *Compt. rend.*, *106*, 1683, *107*, 43, 1888, and subsequently.

[2] Hopkins, F. G., *Bio-chem. J.*, *15*, 286–315, 1921.

[3] Hahn, M., Münchener med. Wochenschrift, S. 595, 1902.

examination of the flour by the writer showed that when it was mixed in a dough with water and the usual amounts of the ingredients of a dough batch, hydrogen sulfide was evolved in quantities sufficient to discolor lead acetate paper immediately, followed by complete blackening, in less than a minute. Doughs made with 50 grams of flour, sufficient water and 1 gram of compressed baker's yeast also evolved hydrogen sulfide.

A dough was made of the flour with water containing hydrochloric acid; this was warmed and the atmosphere above the suspension tested for hydrogen sulfide. The test was negative.

Hydrogen sulfide could be obtained from the flour by the addition of sulfur free zinc and hydrochloric acid. This reaction has not yet been observed with other flours which we have examined in this connection.

We have not yet determined the identity of the sulfur compound present in this flour which is reduced by the living yeast cells, but there is a possibility that the formation of hydrogen sulfide is due to the presence of sulfur or its derivatives absorbed by the flour from the fumigation of a storage warehouse with burning sulfur.

The problem is still under investigation and the writer would appreciate any information or suggestions from those who find this note a matter of interest.

C. B. MORISON

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NINTH ANNUAL MEETING OF THE OPTICAL SOCIETY OF AMERICA

THE Optical Society of America met in Boston from October 23 to 25 for its ninth annual meeting. Three sessions were held at the Massachusetts Institute of Technology, two at Harvard College and one at the Boston Museum of Art.

Among the special features were addresses by Professor Ch. Fabry, of the University of Paris, on "The measurement of light"; Dr. E. R. Berry and Dr. Elihu Thomson, of the General Electric Company, on "The development of clear fused quartz"; Dr. Paul Heymens, of the Massachusetts Institute of Technology, on "Photoelasticity"; Dr. H. E. Ives, of the Western Electric Company, on "The transmission of photographs over telephone lines"; and Dr. Benjamin Ives Gilman, of the Boston Museum of Art, on "Modern solution of the problem of gallery lighting."

The following papers comprised the contributed program:

PHOTOCHEMISTRY, PHOTOGRAPHY AND GEOMETRICAL OPTICS

Report of the committee on photochemistry and photography: S. E. SHEPPARD.

On the relation between time and intensity in photographic exposure: L. A. JONES and EMERY HUSE.

A new non-intermittent sensitometer: ARTHUR C. HARDY.

Report of the committee on geometrical optics: A. E. WRIGHT.

A new instrument for the objective determination of the refraction of the eye: HERMANN KELLNER.

The chromatic aberration of fused bifocal spectacle lenses: W. B. RAYTON.

Image curvature as a function of diaphragm position: I. C. GARDNER and J. J. ARNAUD.

An instrument for the laboratory testing of binocular telescopes: G. W. MOFFITT and PAUL B. TAYLOR.

A direct system of design for the cemented two lens telescope objective: G. W. MOFFITT.

PHYSICAL OPTICS

Report of the committee on physical optics: L. R. INGERSOLL.

An analysis of the arc and spark spectra of chromium: C. C. KIESS.

Visible radiation from solid targets: PAUL D. FOOTE, W. F. MEGGERS and R. L. CHENAULT.

An improved type of illuminator for use in metallographic microscopy: LEWIS E. JEWELL.

The effect of variation of applied voltage, current and power on the candle-power and the spectral energy distribution of incandescent electric lamps: C. MATSUDA.

RADIATION AND PHOTOMETRY

Report of the committee on radiometry and photometry: E. C. CRITTENDEN.

A null method photoelectric photometer: L. BEHR.

Note on the least mechanical equivalent of light: HERBERT E. IVES.

A new method for spectrophotometry: L. A. JONES.

A direct reading spectrophotometer: CARL W. KEUFFEL.

The use of the D'Arsonval galvanometer in radiation measurements: EDISON PETTIT.

New measurements of planetary radiation: W. W. COBLENTZ and C. O. LAMPLAND.

COLOR AND COLOR TERMINOLOGY

An appendix to the English translation of the "Physiological Optics" of Helmholtz: DR. CHRISTINE LADD-FRANKLIN.

Report of the committee on color terminology: CHARLES BITTINGER.

The specification of color in terms of dominant wave-length, purity and brightness: IRWIN G. PRIEST, K. S. GIBSON and A. E. O. MUNSELL.

Spectral centroid relations for artificial daylight filters: K. S. GIBSON.

Applications of colors of similar appearances but different in spectral composition: CHARLES BITTINGER.

PHYSIOLOGICAL OPTICS

Report of the committee on physiological optics: L. T. TROLAND.

On the development of a subjective method of skiascopy: CHARLES SHEARD.

On the chromatic aberration of the eye and the chromatic variations in the interval of Sturm as determined by a subjective method of skiascopy: CHARLES SHEARD.

The sensitivity-intensity law for equilibrium cone minuthesis: L. T. TROLAND and C. H. LANGFORD.

The stability of hue under chromatic minuthesis: L. T. TROLAND and C. H. LANGFORD.

Instantaneous photomicrography of the capillaries in the living human body: CHARLES SHEARD.

Note on the subjective observation of the blood corpuscles in the retinal capillaries: CHARLES SHEARD.

PICTORIAL ART AND VISION

The illusion of depth from single pictures: ADELBERT AMES, JR.

Pictorial art and the physiology of vision: ADELBERT AMES, JR.

Most of these papers will appear in full in the *Journal of the Optical Society of America and Review of Scientific Instruments.*

The next annual meeting will be held at Cornell University in October, 1925.

The officers of the society are: Dr. H. E. Ives, of the Western Electric Company, *president;* Dr. W. E. Forsythe, of the Nela Research Laboratory, *vice-president;* Professor F. K. Richtmyer, of Cornell University, *secretary;* and Mr. Adolph Lomb, of the Bausch and Lomb Optical Company, *treasurer.*

F. K. RICHTMYER

CORNELL UNIVERSITY

AMERICAN MATHEMATICAL SOCIETY

THE two hundred and thirty-seventh regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, October 25, 1924, extending through the usual two sessions. The attendance included fifty members of the society.

The secretary announced the election of the following sustaining members: Allyn and Bacon; the Babcock and Wilcox Company; Dartmouth College; the General Electric Company (patron); Ginn and Company; the Insull Interests, of Chicago (patron); Mr. E. W. Rice, Jr., of the General Electric Company; the Union Central Life Insurance Company, of Cincinnati; the University of Washington; the Western Electric Company (patron); the Westinghouse Company (patron). He also announced the election of 153 ordinary members, of whom 73 are nominees of sustaining members.

The following papers were read:

Note on a transformation of the hypergeometric series: B. H. CAMP.

A new type of double sextette closed under a binary (3, 3) correspondence: LOUISE D. CUMMINGS.

Reduction of Euler's equations to a canonical form: J. H. TAYLOR.

Necessary and sufficient conditions that every closed and connected subset of a continuous curve be a continuous curve. Second paper: H. M. GEHMAN.

The rotating disk: PHILIP FRANKLIN.

The electric currents in a network: PHILIP FRANKLIN.

On simple groups of low order: F. N. COLE.

On the roots of the Riemann zeta function: J. I. HUTCHINSON.

A note on regular singular points: EINAR HILLE.

Four methods for solving the problem of the rectangular beam: C. A. GARABEDIAN.

Some two-dimensional loci: J. L. WALSH.

A uniqueness theorem for the Legendre and the Hermite polynomials: K. P. WILLIAMS.

On the prime divisors of the cyclotomic functions: C. M. HUBER.

Functional invariants, with a continuity of order p, of one-parameter Fredholm and Volterra transformation groups: A. D. MICHAL.

On certain new topological invariants: J. W. ALEXANDER.

The interpretation of non-integral exponents with notes on the theory of subponents: W. O. PENNELL.

The representation of bounded functions by trigonometric integrals: NORBERT WIENER.

A general type of singular points: EINAR HILLE.

The geometry of frequency functions: DUNHAM JACKSON.

Elementary functions and their inverses: J. F. RITT.

On the impossibility of solving certain differential equations in finite terms: J. F. RITT.

On singularities in analytical physics: G. Y. RAINICH.

The analytic function on a minimal surface: G. Y. RAINICH.

On the gradient of a functional. Preliminary communication: DUNHAM JACKSON.

Extension of a theorem due to Lerch: T. H. GRONWALL.

On the Cesàro summability of Fourier's and Laplace's series: T. H. GRONWALL.

A note concerning closed non-dense linear sets which are enumerable: J. R. KLINE.

The annual meeting of the society will be held at Washington, D. C., from December 29 to 31, in affiliation with the American Association for the Advancement of Science. On this occasion President Veblen will deliver his retiring address, and Mr. Robert Henderson will deliver the second Josiah Willard Gibbs Lecture.

R. G. D. RICHARDSON,
Secretary

SCIENCE

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CONTENTS

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BIOLOGICAL ABSTRACTS

ON November 26 of last year the secretary of the Union of American Biological Societies submitted to American biologists individually the report of the Joint Publications Committee of the Union and of the Division of Biology and Agriculture of the National Research Council. This report[1] outlined a tentative plan for providing biologists with a comprehensive abstracting and indexing service. In sending this report the secretary made provision for an expression from biologists individually on the main issues involved—the plan itself and the individual support through subscriptions that it might expect if established. The secretary, Dr. I. F. Lewis, University of Virginia, has requested the Joint Publications Committee to study and report on the about 4,500 replies received. The following report is, therefore, submitted by the Joint Publications Committee.

Before reporting on the referendum, it will be well to recall briefly the events and considerations which led up to the proposal to develop a comprehensive biological abstracting service.

In 1921 a conference representing the American Society of Naturalists, American Society of Zoologists and Botanical Society of America considered the question of providing adequate organization facilities for geneticists, without at the same time adding to the already large number of independent biological societies and thereby increasing still more the difficulties of concerted effective effort in larger problems of importance to biologists generally. Following the suggestions of the conference, sections in genetics with common officers were created in the American Society of Zoologists and the Botanical Society of America. However, the conference recognized that with the inevitable continued diversification similar necessities would arise from time to time; also that important problems concerning biologists generally were already demanding attention. It was, therefore, suggested that representatives of the various national research biological societies discuss the advisability of establishing a union. The Division of Biology and Agriculture of the National Research Council was appealed to as a disinterested body to call a conference. Such a gathering was held at the Toronto meeting of the American Association for the Advancement of Science in 1921 and participated in by representatives of nearly a score of societies. Out of this meeting grew a second request to the National

[1] SCIENCE, September 28, 1923, pp. 236–239.

Research Council, this time to call essentially an adjourned meeting of the society representatives for more extended and detailed consideration of the union proposal. This second gathering occurred in Washington, April, 1922,[2] where action was taken resulting a year later in the official establishment of the Union of American Biological Societies, to which by formal action the following societies are now adhering (others have been invited to adhere):

American Association for the Advancement of Science—Sections F, G, N and O
American Association of Anatomists
American Association of Economic Entomologists
American Dairy Science Association
American Genetic Association
American Physiological Society
American Phytopathological Society
American Society of Agronomy
American Society for Horticultural Science
American Society of Naturalists
American Society of Zoologists
Botanical Society of America
Ecological Society of America
Society of American Foresters
Society of American Bacteriologists
Entomological Society of America

Although at both the Toronto and Washington conferences consideration was given to a variety of important problems, there is little doubt that the possibility of greatly improved abstracting and indexing services in biology through strong united effort was largely responsible for the general sentiment favoring the establishment of a union. At the latter conference, a year in advance of the official consummation of the union, a Publications Committee was appointed with instructions to function jointly with a similar committee appointed almost simultaneously by the Division of Biology and Agriculture of the National Research Council. Subsequently, the American Association for the Advancement of Science acting on the invitation of the Union and the National Research Council, arranged for representation on the Joint Publications Committee.

At the organization meeting of the council of the Union in April, 1923, the Publications Committee made the report to which reference has already been made in the opening paragraph. It will be recalled that this report outlined a project for publishing a single comprehensive biological abstracting journal under the auspices of the Union of American Biological Societies and which looked forward to possible eventual uniform support from members of the societies comprising the Union on somewhat the basis on which all members of the American Chemical Society automatically support *Chemical Abstracts* through their membership dues. The latter arrangement, as is well known, has been notably fruitful in providing chemists with enviable abstracting and indexing sevvices at phenomenally low cost to the individual.

[2] SCIENCE, September 29, 1922, pp. 359–361.

Although this report was approved by the council of the Union and by the Division of Biology and Agriculture of the National Research Council, it was felt that biologists individually had not had the opportunity of examining the proposal and of expressing themselves concerning it. Therefore, as already stated, it was sent by the secretary of the Union to about 6,700 American biologists individually, who, after examining the report, were invited to express themselves on the following two questions and to submit in addition suggestions or comments:

(1) Do you favor the project of publishing a single comprehensive biological abstracts journal?

(2) Without committing yourself finally, is it likely that you would support such a journal by subscription?

The nearly 4,500 replies received distribute themselves, in percentage, as follows:

	Question 1	Question 2
Yes	84.3 per cent.	55.99 per cent.
No	7.9 " "	18.8 " "
Probably		5.5 " "
Undecided	1.4 " "	
No vote	6.2 " "	5.2 " "
Through institution		2.9 " "
Total	99.8 per cent.[3]	88.39 per cent.[3]

By societies, these replies distribute themselves approximately as follows (owing to the extensive overlapping in membership between many of the societies the sum of the totals for the several societies exceeds the total number of individual replies received):

	Question 1		Question 2	
	Yes[4]	No[4]	Yes[4]	No[4]
American Society of Agronomy	238	17	167	82
American Association of Anatomists	215	8	184	30
American Society of Animal Production	118	15	102	29
Society of American Bacteriologists	578	47	480	125
Botanical Society of America	519	53	449	131
American Dairy Science Association	99	11	101	32

[3] Lack of space prevents printing the numerous additional categories resulting from votes qualified in one way or another; hence the total percentages here recorded are less than 100.

[4] To conserve space, only affirmative and negative votes are tabulated.

	Question 1 Yes	Question 1 No	Question 2 Yes	Question 2 No
Ecological Society of America	378	29	309	79
American Association of Economic Entomologists	342	32	268	96
American Entomological Society	266	31	308	83
American Physiological Society	162	24	126	61
American Society of Biological Chemists	121	24	89	56
American Society of Experimental Therapeutics	46	8	24	23
American Society of Experimental Pathology	17	3	12	18
Society of American Foresters	268	31	124	206
American Society for Horticultural Science	121	16	92	38
American Society of Mammalogists	238	27	171	89
American Society of Naturalists	255	22	207	54
American Phytopathological Society	309	42	278	62
American Society of Zoologists	281	9	269	19

In addition to this unexpectedly large response, the replies contained many interesting comments, suggestions and questions. A large number of these augment in one way or another the affirmative replies to one or both questions, besides offering many thoughtful suggestions. The remainder, which fall logically into groups, offer certain very natural and pertinent questions and criticisms. The committee regards it as essential to present those considerations about which the questions and criticisms chiefly center and which in nearly every case are also those to which the joint committee gave especial attention before formulating its report.

(1) *Concern for the existing abstracting services if a competing service is inaugurated.* The difficulties besetting many of the services in English have in a large measure furnished the stimulus for the committee's efforts; this is especially true inasmuch as the very existence of some is threatened. The committee is, therefore, glad of the opportunity to make it clear that there has been no thought of merely setting up a rival publication; the effort has been to find a more adequate and enduring basis for this important work, which in most cases the existing agencies are struggling to perform under very trying circumstances.

From the evidence at hand the committee concluded in its report that this basis for biology would most likely be furnished by a single, comprehensive, well-supported abstracting and indexing service. From what has been said, and—considering for the moment merely the American efforts—from the fact that many of the societies comprising the Union of American Biological Societies are already conducting or cooperating in abstracting journals, it is evident that the establishment of a merely competitive service by the Union is inconceivable. If, on the other hand, the existing services should find the proposals of the Union sufficiently sound and practicable in providing more adequately and permanently for the work which they severally are doing, a voluntary cooperative merger of sufficient magnitude might result which would prepare the way for the inauguration of the more comprehensive service, provided always the necessary financial support to guarantee editorial excellence for at least a considerable period of years is assured, as stipulated in the committee's report. Although the committee is not authorized to speak for the bodies conducting existing abstracting services it may be mentioned that several of these have already expressed their willingness to effect a merger.

It is, of course, thoroughly recognized that some of the services in English, as in other languages, have objectives of such character, render such special or unique services or are by statute or other provisions so obligated that their independent continuance would not only be entirely justified but highly important. With these as well as with other agencies, irrespective of language, every effort should be made to arrange mutually helpful cooperative relations should the more inclusive service be inaugurated.

(2) *Separate journals for botany and zoology preferred* (using the terms in the broad sense of plant and animal science). The committee gave much attention to the development of separate services along the lines of this traditional division of biology. In such fields as taxonomy, morphology, anatomy, etc., such a division presented no marked difficulties, except in the Protista. However, serious difficulties were encountered in certain fields in which such a division would cleave through the very center of the subject, notably in genetics, cytology, evolution and other aspects of general biology; to an increasing degree this is true also for physiology, pathology, ecology, etc. On the whole, therefore, the division of biology into plant and animal did not commend itself to the committee.

(3) *Separate journals for the various more special fields preferred.* This alternative naturally suggested itself, especially after it appeared inadvisable to divide the field into plant and animal science. It is, of course, the procedure on which biologists have already embarked to a considerable extent, as evidenced by the scores of listing and abstracting journals or sections of journals which concern themselves with more or less restricted fields. The invaluable services which these services of narrower scope are performing led the committee to study also this proce-

dure as possibly furnishing a basis for working out plans to provide approximately all biology with adequate abstracting and indexing facilities. As was pointed out in the committee's report, three closely connected major practical difficulties presented themselves:

(a) In order that an abstract journal of narrow scope may meet the needs of its constituents it finds itself under the necessity of reaching extensively into neighboring fields. The result is a very extensive duplication with attendant increased costs.

(b) The special abstracting journals, because restricted to limited fields, can in most cases command but relatively limited numbers of subscribers with the result that even though the subscription rate be high it is usually considered fortunate if the income secured is sufficient to meet the costs of printing and distribution. In those relatively rare cases in which such income contributes anything to the editorial expenses, the amount is largely insufficient to provide at all adequately and continuously for the large amount of exacting abstracting, editorial and bibliographic and clerical work involved. The result is that

(c) all or nearly all the work attendant upon the production of such journals is on a volunteer basis. The committee recognizes fully the very great value of these volunteer services and that this basis provides certain advantages in esprit de corps, devoted services and often elevated standards which should be carefully preserved in any modification of present practice. But it is usually inevitable that the burden must be borne by those who can with difficulty and sacrifice give but limited attention to the tasks, since their responsibilities necessarily lie mainly in other directions. Under these circumstances it is not surprising that discontinuity has been rather characteristic of these services of narrower scope; also that usually it has been impossible for them even to approximate their objectives. Exception must here be made of a few services, especially in certain applied fields, which through special support have been able to render able service consecutively for longer periods of time. Thus, in looking the biological field over in general, it becomes obvious that adequate provision exists in only a very fragmentary way, and that frequently the services devoted to the less immediately applied aspects of biology have had greatest difficulty in maintaining themselves.

The alternative which in the judgment of the committee offers the best prospect for improvement is a single comprehensive service, not only because it would effect marked savings through avoidance of costly duplication and secure the well-recognized advantages to the subscriber of large editions, but also because efforts to secure adequate financial support to guarantee editorial excellence give greater promise of success if sponsored by the larger and responsible group of biologists which would be served by such an enterprise, a group which is already largely represented in the Union. The committee does not, however, favor the plan of a single comprehensive service solely on financial grounds. It seemed to offer also an excellent opportunity to insure the healthy interaction of the various aspects of biology without at the same time jeopardizing its usefulness in restricted fields. It is, of course, realized that equally important is the interaction of biology with aspects of the other major sciences, such as chemistry, physics, geology, psychology. But boundaries must on practical grounds be established, the approximate location naturally being influenced by the general scope adopted by services in the other major sciences. Obviously no lines can be drawn which will not prove inconvenient to some.

(4) *Only part of the contained material would be of interest to the individual.* Unless the scope is a very narrow one this observation from the scientist's point of view applies more or less to all literature aids. Generally approved groupings of materials in subject-matter sections accompanied by convenient tables of contents should provide, as elsewhere, the necessary facilities for consulting the current material of interest individually with the same ease as in the issues of journals of more restricted scope.

(5) *Publication would be too bulky.* In considering this aspect of the problem the committee early inquired into the experience of *Chemical Abstracts,* which issues annually approximately as many pages of abstracts and indexes as the committee estimates would be required for an equally complete service in biology. The committee did not find that the matter of bulk in this highly successful and valuable journal had ever emerged as a serious problem. The committee has further investigated printing papers and, as previously reported, finds available very satisfactory thin papers. There would be no difficulty in supplying an edition on such paper to those subscribers who might prefer it.

* * * *

Discussions have also been held in fifteen or twenty biological centers, where almost without exception the general plans of the Union met with practically unanimous favor.

* * * *

The executive committee of the Union thus felt it could with the approval of biologists generally proceed to the next step, namely, endeavor to secure the necessary financial support for at least a consid-

erable period of years to guarantee editorial excellence; it will be recalled that such provision is basic in the proposal. These endeavors, with the active support of the National Research Council, are under way.

Finally, with American interest and cooperation assured, efforts will be made to secure international participation, without which no complete service can be rendered.

HERBERT OSBORN,

Representing the American Association for the Advancement of Science

A. PARKER HITCHENS,
D. R. HOOKER,
C. A. KOFOID,
I. F. LEWIS,

Representing the Union of American Biological Societies

E. D. BALL,
C. E. MCCLUNG,
J. R. SCHRAMM,
A. F. WOODS,

Representing the Division of Biology and Agriculture of the National Research Council

M. J. GREENMAN,

Member at Large.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PERMANENT SECRETARY'S ANNUAL REPORT

THE following paragraphs report on the most important matters that have had the attention of the permanent secretary's office during the year ending September 30, 1924.

PUBLICATIONS

Two special issues of SCIENCE (for January 25 and February 1, 1924) were devoted to brief reports of the last annual meeting, which was held in Cincinnati. A new edition of the booklet of information was published in the spring, and 25,000 copies of it have been sent to prospective members. A smaller booklet, on the organization of the association, was published and copies were sent to those interested in linguistic sciences.

Plans and arrangements have been completed for the preparation of the next volume of the Summarized Proceedings, which is to contain the new directory of members of the association. The volume is to be published next fall.

ORGANIZATION

Philological Sciences: The special committee on philological sciences (authorized at the last annual meeting) has been active throughout the year, and a program on linguistic sciences has been prepared for the fifth Washington meeting. The movement to organize these sciences in the association continues to arouse interest among philological workers.

Divisions and academies: The arrangements with the two divisions and with the local branch, as well as with the twelve affiliated academies of science, have been continued. The association has paid to these organizations the following amounts for the last four fiscal years:

	1921	1922	1923	1924
Pacific Division	$1,007	$1,126	$1,133	$1,339.00
Southwestern Division	131	149	224	242.00
Local Branch (State College, Pa.)	—	27	29	30.50
Affiliated Academies	1,141	1,328	1,440	1,467.00
	$2,279	$2,630	$2,826	$3,078.50

It will be recalled that these payments are made as allowances to aid the work of these organizations. The divisions and the affiliated academies each receive one dollar a year for each of their members who pays dues in the association. The local branch receives similar allowances of fifty cents. Several academies of science have applied for affiliation, but no action has yet been taken on their applications, pending the decision of questions regarding the entire arrangement of affiliated academies. The finances of the association will not permit further considerable increase in the annual allowances to the affiliated academies unless the arrangement of affiliation may be made to result in more pronounced annual increases in association membership. It will be remembered that the current expenses of the association must be met from the annual dues contributed by members and that the portion of these contributions that is available for this use after purchasing the journal subscription is $2 for each member in good standing. In the case of division and affiliated academy members half of the two-dollar balance is paid to the division or academy, leaving only $1 for the account of current association expenses. In most instances the academies credit the dollar allowances received from the association to annual academy dues of their members, and the association allowance is consequently received by the academy in lieu of an equal fund that would otherwise be received by the academy from its association members if they were to pay academy dues. The academy allowance for

the fiscal year just ended ranges in amount from $302 to $13 and the number of new association members received through the academies during that year ranges from 12 to 1. During the last four years the association has paid to the affiliated academies in allowances $5,277 and it has received 285 new members through academy activities during that period. Association entrance fees received from new members joining through affiliated academies are turned over to the academies. This whole question of academy affiliation clearly requires serious attention and it is hoped that some modifications in the arrangements may be decided upon which will retain all the present mutual advantages and will permit the association to bear its share of the cost of the excellent work that is being carried forward by the academies of science.

Fellowship in the association: The problem regarding the qualifications necessary for election to fellowship in the association has received the attention of two successive committees during the fiscal year just ended, as well as being considered by the executive committee. Because the wording of the by-laws is somewhat vague in this respect the section committees have experienced some difficulty in caring for recommendations for election to fellowship and they have asked that fellowship qualifications be more clearly defined. This problem is an important one in the organization of the association, and a feasible solution should be worked out in the near future. The by-laws state that all members who are professionally engaged in scientific work shall be considered eligible to fellowship and that other members shall be so eligible if they have advanced science by research. The primary difficulty arose in attempting to interpret the phrase regarding professional engagement. For ready reference, Article II, Section 4, of the By-Laws and Rules of Procedure of the association, is here reproduced.

All members who are professionally engaged in scientific work, or who have advanced science by research, may be elected by the council to be fellows on nomination or on their own application. This qualification is understood to have been met by members of affiliated societies having a research qualification.

Affiliation of Societies with the Association

The following named organizations have become affiliated with the association during the fiscal year just ended:

American Electrochemical Society (affiliated with Section C), two representatives in A. A. A. S. council.

American Ceramic Society (affiliated with Section M), one representative in A. A. A. S. council.

There are now eighty-one associated organizations, of which forty-five are affiliated.

Membership

The membership of the association has increased remarkably during the fiscal year here considered. The number of members in good standing increased from 10,787 (September 30, 1923) to 12,130 (September 30, 1924), while the total number of names on the roll increased correspondingly from 11,704 to 12,887. This gratifying feature of our work is probably partly due to the remission of entrance fees during 1924 to all new members who were already members of some affiliated society. It is doubtless largely due, also, to a thorough circularization of all members of affiliated societies who were not already association members. Letters of invitation were sent to 65,725 persons. Details concerning membership are shown in the accompanying table.

Membership in the Association,
September 30, 1923, to September 30, 1924.

	Sept. 30, 1923	Sept. 30, 1924	Increase (+) or Decrease (—)
Sustaining members	3	3	
Life members	373	383	(+) 10
Annual members, paid-up	10,411	11,744	(+) 1,333
Total in good standing	10,787	12,130	(+) 1,343
Members in arrears for 2 years	407	326	(—) 81
Members in arrears for 1 year	510	431	(—) 79
Total enrollment	11,704	12,887	(+) 1,183

Gain in membership, October 1, 1923, to September 30, 1924:		
Reinstatements	15	
New members (3 Life, 1,956 Annual)	1,959	
Total gain		1,974
Loss in membership, October 1, 1923, to September 30, 1924:		
Dropped for non-payment of dues	407	
Resignations	263	
Deaths	121	
Total loss		791
Net gain, October 1, 1923, to September 30, 1924		1,783
Transfers from *annual* membership to *life* membership	20	

The growth of the association, as regards membership, since September 30, 1920, is shown by years in the following tabulation.

Growth in Membership

	Sept. 30, 1920	Sept. 30, 1921	Sept. 30, 1922	Sept. 30, 1923	Sept. 30, 1924
Members in good standing:					
Actual no.	10,002	10,160	10,566	10,787	12,130
Percentage of total enrollment.	87.42	87.99	90.73	92.17	94.13
Percentage increase during preceding year	——	1.58	4.00	2.10	12.45
Total enrollment:					
Actual no.	11,442	11,547	11,646	11,704	12,887[1]
Percentage increase during preceding year	——	0.92	0.86	0.50	10.11

It is specially interesting to note that the number of members in good standing at the end of the fiscal year represented only 87 per cent. of the total enrollment on September 30, 1920, while it represented 94 per cent. on September 30, 1924.

Financial Affairs

The permanent secretary's financial report for the fiscal year 1923–24 will be published in Science after presentation to the council at the approaching Washington meeting. The total disbursements for the year amounted to $66,737.15 and left an available balance of $3,161.17 on September 30 last. Besides this there are, as liabilities, (1) the fund for the study of the place of science in education (received from the Commonwealth Fund, of New York) and (2) the publication fund. The publication fund will be used in 1925 for the publication of the new volume of Summarized Proceedings.

The same anonymous donor who made possible the $1,000 Cincinnati prize has placed in the hands of the association the sum of $5,000, to be used for five similar prizes, one each year for five years. This fund is in the treasurer's hands.

Cooperation with the British Association for the Advancement of Science

No summer meeting of the association was held in 1924. Instead of holding the meeting that had been contemplated it was decided to accept a cordial invitation from the British Association inviting all members of the American Association to attend the annual meeting held in Toronto from August 6 to 13. The permanent secretary's office was supplied with copies of the preliminary program of the Toronto meeting, and a copy was mailed to each member of the American Association about June 17. The apparatus for the visible directory, used at our recent annual meetings for maintaining a readily consulted list of those in attendance, was loaned to the local committee at Toronto and was employed at the Toronto meeting. A large number of our members were in attendance. At the close of that meeting the British Association passed a vote of thanks to the American Association for its cooperation, as well as one to the local committee at Toronto. The resolution expressing appreciation of the cooperation of the American Association reads as follows:

Resolved, that the best thanks of the British Association be accorded to the American Association for the Advancement of Science for their cordial and effective cooperation.

Preparations for the Fifth Washington Meeting

Preparations for the fifth Washington meeting are well advanced. The local committees are showing great interest and efficiency. Two evening sessions for Monday and Tuesday have been arranged. The first is the opening session and the second is for the Sigma Xi lecture by Dr. Frederick Fuller Russell. Thirty-nine societies are planning to meet with the association at Washington.

All members residing in Washington and vicinity have been asked to make financial contributions of $5 or more toward the extra expenses of the meeting.

The names of members of the local committees and of the section representatives for the meeting have been published in Science, for August 29, 1924.

Burton E. Livingston,
Permanent Secretary

WILLIAM A. LOCY—1857–1924

On the ninth of October, 1924, American scholarship lost one of its most genial spirits by the unexpected death of Professor William A. Locy, who, for more than a quarter century, had filled the chair of zoology in Northwestern University.

William Albert Locy was born, of Dutch ancestry, at Troy, Michigan, on the 14th of September, 1857. The family had emigrated from Holland in 1651, settled in Dutchess county, New York, and later removed to the west. Graduating from the University

[1] The total enrollment has continued to increase; it was about 13,050 on November 1, 1924.

of Michigan, in 1881, in the days when this institution was the outstanding one among all those west of the Alleghanies, he remained with his *alma mater* as a graduate student. His biological tastes were already well marked.

It was in 1885 that he was married to Miss Ellen Eastman, daughter of Dr. Joseph Eastman, of Flint, Michigan. They have two sons, one engaged in commercial work in Kansas City, the other a surgeon in the United States Navy.

Dr. Locy's earliest biological contribution is dated from Mt. Morris College, Illinois, where he had as colleagues Professors Fernando Sanford and Jeremiah W. Jenks. During the year 1884–5 he held a fellowship at Harvard, and completed, in the laboratory of Dr. Mark, a noteworthy embryological investigation on "The development of *Agelena naevia.*" In the autumn of 1887 he accepted the chair of biology at Lake Forest University and remained there for nine years. His work, at this period, had to do with "The embryonic development of the elasmobranchs," "The derivation of the pineal eye," "The structure and development of the vertebrate head." This last mentioned research on cranial morphology was accepted by Professor C. O. Whitman as a thesis for the degree of doctor of philosophy at the University of Chicago in 1895. The University of Michigan, in 1906, conferred upon him the honorary degree of Sc.D.

His contributions to zoological research evidenced great power of observation, extreme care, an active scientific imagination and strong sense of the fundamental. He therefore engaged in no petty researches, and the few that he published include at least two that are landmarks in their respective fields. His study of the embryonic neuromeres of the fore and mid-brain of fishes stands in the fore-front of investigation on neural metamerism, and in the center of the controversy that still continues on this subject. His study of the *nervus terminalis* in Elasmobranchs, while not contributing an entirely original discovery of this addition to the classical roster of cranial nerves, was nevertheless contributed so early and was so thorough as to dominate and become the standard for all later investigations.

Two different interests are clearly marked in the work of Locy, shortly after he came to Northwestern University, in the spring of 1896, to succeed Professor E. G. Conklin. The first of these interests shows itself in his continued attention to the developmental history of the sense-organs: the other is a new interest in the developmental history of the science of biology. The former is typified by his paper on "Accessory optic vesicles in the chick embryo," another on "A newly recognized nerve connected with the forebrain of Selachians," a third on "The fifth and sixth aortic arches in birds and mammals," and also by various researches made by graduate students, working in Locy's laboratory: the latter current of thought is marked by a series of historical papers, beginning with sketches of "Malpighi, Swammerdam and Leeuwenhoek" in the *Popular Science Monthly* (1901). In later years, these historical interests, first awakened by Whitman, came to absorb almost his entire leisure time and energy. In 1908 appeared his collection of historical portraits, entitled "Biology and Its Makers," a non-technical work, which has been well received in English-speaking countries, has been translated into German, and has met an enthusiastic reception at the hands of students. Ten years later came a volume on the "Main Currents of Zoology," a well-balanced treatment of how we came to know what we have learned about animal life, an elementary discussion which is marked throughout with fine perspective and with precision of statement. At the time of his death, he was just completing the manuscript of a book, tracing "The Rise of Biology," from the earliest times up to the beginning of the present century, assigning to the various steps and stages, in biological thought, their proper relative importance.

When the American Association for the Advancement of Science decided to create a new section devoted to the history of science, Locy was chosen as the first president of the section. The work which he has thus accomplished, in conjunction with that of Sarton, Libby, Henderson, Karpinski and others, represents for America much the same progress as that which has been made in England by Singer, Marvin, Shipley and Allbutt. In 1915 the American Society of Zoologists elected him to its presidency. From 1901 to 1903 he was trustee of the Marine Biological Laboratory, at Woods Hole, Mass.

At various times, Locy's teaching was interrupted by trips to Europe, the last of which he and his wife made during a sabbatical leave in 1902–3, on which occasion several months were spent in research at the zoological station in Naples. Earlier, in 1891, he had studied physiology in Berlin, where he embraced the opportunity of hearing DuBois-Reymond.

Not the least important part of Locy's work was that which he accomplished through the inspiration of and by the assistance of his graduate students. He was always full of enthusiasm and vigor for any genuine effort to extend the borders of human knowledge. His scholarship was of a type which is comprehensive, accurate and exacting. To the most elementary students he also gave his best and taught the introductory course in general zoology as long as he lived. In addition to these qualities,

he possessed the saving grace of humor and a geniality of spirit which made him a most enjoyable member of many social groups, such as the University Clubs of Evanston and Chicago and the Chaos Club of Chicago.

By his untimely death America has lost a noteworthy scholar and many of us a loyal, generous and warm-hearted friend.

HENRY CREW,
FRANK R. LILLIE

SCIENTIFIC EVENTS

REDUCED RAILWAY RATES FOR NON-MEMBERS ATTENDING THE WASHINGTON MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE privilege of reduced railway rates that has been secured for the approaching Washington meeting of the American Association and associated organizations is not to be confined to members of the association itself. The reduced rates are to be available to all members of any associated society, whether the society meets with the association or not, and also to all members of every other society that meets with the association at this time.

Those who intend to come to the Washington meeting from outside of the immediate vicinity should state that they are going to attend the meeting of the American Association for the Advancement of Science, even though they have not yet become members of that organization, when they purchase their tickets to Washington. Those who are not yet members will be regarded as guests of the association. The names of the numerous other organizations that are planning to meet with the association in the approaching convocation week will not appear on the lists of the railway agents and should not be mentioned when tickets are purchased.

A certificate on the standard certificate form (*not a receipt*) is to be secured from the railway agent from whom the going ticket to Washington is bought. This railway certificate is to be left at the validation desk in the registration room (in the New Willard Hotel, Pennsylvania Ave. and 15th St., N. W.), as soon as possible after arrival in Washington. It will be endorsed by the agent of the American Association and validated by the railway agent, after which it will be returned to the owner. Upon presentation of a properly endorsed and validated certificate, the ticket agent at Washington will sell a one-way returning ticket for half the regular one-way fare. Thus the total railway fare paid for both going and returning will amount to one and one half times the regular one-way fare for the distance traveled. This is the same arrangement as the one in force at recent annual meetings. It applies for practically all stations in the United States and also in Canada with the exception of those on lines of the Western Canadian Association (in Alberta, Saskatchewan, Manitoba and Ontario west of Port Arthur and Armstrong). Those coming to the meeting from stations outside of the region of reduced rates should purchase round-trip tickets to some point within the region and thence proceed as above, or else they may purchase round-trip tickets to Washington (with generally less reduction in fare).

A list of organizations planning to meet with the association in Washintgon this year appeared in SCIENCE for August 29, 1924, page 193. The following names should now be added to the list there published:

American Fern Society.
American Nature-Study Society.
Wild Flower Preservation Society.
Phi Sigma Biological Research Society.
American Political Science Association.
History of Science Society.
Crop Protection Institute.
Society of American Foresters.
American Federation of Teachers of the Mathematical and Natural Sciences.
Gamma Sigma Delta Society.
Sigma Delta Epsilon Graduate Women's Scientific Fraternity.

Besides the fifteen sections of the association there will be, in all, forty-four societies meeting with it this year. An exceptionally satisfactory meeting is anticipated.

BURTON E. LIVINGSTON,
Permanent Secretary

ENDOWMENT FUND AND GRANTS OF THE CARNEGIE CORPORATION OF NEW YORK

PRESIDENT F. P. KEPPEL submitted his first yearly report to the trustees of the Carnegie Corporation at the annual meeting of the board on November 20. According to his report and the report of the treasurer, on October 1, 1923, the assets of the corporation stood at $133,659,024.17, of which $124,936,275.44 constituted the value of the original endowment, and the remainder cash and securities accumulated out of income. During the year, the income of the corporation amounted to $7,397,714.13.

In effect, the trustees are responsible for two trusts: one "for the advancement and diffusion of knowledge and understanding among the people of the United States" and one for similar purposes in Canada and other British dominions. As regards the former trust, the corporation during the past year paid out $12,948,619.10. Of this total $12,349,110.72 was based upon grants voted by the corporation in previous years.

For the latter fund, the corresponding figures are as follows: amount paid out—$89,399.29, of which $29,500.00 was based upon grants voted in previous years.

During the same period, grants were voted from income of the principal fund, amounting to $2,448,540.94, of which $1,615,599.98 were absolute and $808,940.96 were conditional. For the fund applicable elsewhere than in the U. S. A., the total of grants was $757,575.01.

The list of grants is headed by the Carnegie Institute of Pittsburgh which received the largest single grant in the history of the corporation, amounting to $16,327,376.25. Of this sum, $8,000,000 was paid over to the Pittsburgh authorities in June, 1924. Other large grants upon which reports of progress are made, together with the amount of each grant, are as follows: The National Research Council and the National Academy of Sciences, $5,000,000; educational institutions in Eastern Canada, $3,000,000; Institute of Economics, $1,650,000; National Bureau of Economic Research, $150,000; Institute for Research in Land Economics and Public Utilities, $62,500; Food Research Institute, located at Stanford University, California, $704,000; American Law Institute, engaged in formulating a restatement of the law, $1,075,000; the Johns Hopkins Medical School for an out-patient building and diagnostic clinic, $2,000,000; New York Academy of Medicine, $1,000,000.

Among the more important grants made during the current year are included the following: American Library Association, for general support and for the conduct of certain special activities, $164,100; Carnegie Endowment for International Peace, to aid in publishing an economic and social history of the world war, $350,000; Harvard University, for the training of personnel for museum service, $100,000; Institute of International Education, $182,500; Society for the Promotion of Engineering Education, $108,000; University of California, for a study of pyorrhea and its possible relation to other human maladies, $85,000; National Institute of Public Administration, $40,000; Committee on Legal Aid Work, $85,000; Union University, for the Albany Medical College, $52,500; Junior College, St. John's, Newfoundland, $75,000, and University of King's College, for endowment, $600,000 (part of $3,000,000 gift for education in Eastern Canada); and to various agencies for research in insulin, $43,000.

BARRO COLORADO ISLAND LABORATORY

The United Fruit Company has renewed its generous offer of last year of a small number of passes on its boats between New York and Colon for properly accredited scientific investigators who wish to work at the Barro Colorado Island Laboratory.

The company offers to provide five round-trip passes in 1925 to workers properly accredited to the National Research Council by the executive committee of the Institute for Research in Tropical America. These passes do not include meals, which are charged for at an inclusive rate of $5 per day.

Applications for such passes should be addressed to Dr. Thomas Barbour, acting chairman of the executive committee of the Institute for Research in Tropical America, in care of the National Research Council, Washington, or at the Museum of Comparative Zoology, Cambridge, Massachusetts.

Vernon Kellogg,
Permanent Secretary,
National Research Council

THE WILMER FOUNDATION

Trustees of Johns Hopkins institutions have joined the Wilmer Foundation in a campaign to establish a $3,000,000 foundation for the endowment at Baltimore of an eye hospital and school which, would be the first of its kind in America, and the equal of any in the world.

The plan is for an institution for the study and treatment of diseases of the eye, for research into causes of blindness and kindred ailments and for the education of American specialists, who heretofore have had to attend European universities and clinics to perfect themselves for the practice of ophthalmology.

Forty free beds are to be endowed. Additional facilities are to be installed for the treatment of patients who lack the means to pay for hospital care.

The institution will be conducted as a unit of the Johns Hopkins University's Medical School and Hospital. It will bear the name of Dr. William Holland Wilmer, of Washington, a noted ophthalmologist, and will be directed by him, according to Dr. Frank J. Goodnow, president of Johns Hopkins University, in whose name announcement of the project was made.

Dr. Goodnow said that it would cost about $1,000,000 to erect and equip the Wilmer Institute. Another $1,000,000 will be required to endow the free beds and other charitable features and the additional $1,000,000 to endow the teaching of ophthalmology and to pay members of the staff, who also will be officers of Johns Hopkins Hospital and members of the medical faculty.

The nucleus of the fund will be $200,000, contributed by friends and patients of Dr. Wilmer. Several years ago they incorporated the Wilmer Foundation for the endowment of an institution which would give his abilities greater scope. When trustees of this fund learned that Johns Hopkins contem-

plated an institute of ophthalmology it was arranged to make it a joint undertaking.

Henry Breckinridge, of New York, secretary-treasurer of the Wilmer Foundation, has announced plans for increasing the original $200,000 to nearly $500,000. The first $1,000,000 will be sought from the General Education Board, founded by Mr. Rockefeller. The trustees of Johns Hopkins have not yet taken final action.

THE ELLIOT MEDAL FOR 1924

Nominations for the award of the Elliot Medal for the year 1924 should be addressed to the secretary of the National Academy of Sciences, Washington, D. C. The terms of the award in the Daniel Giraud Elliot deed of gift are as follows:

One such medal and diploma shall be given in each year and they, with any unexpended balance of income for the year, shall be awarded . . . to the author of each paper, essay or other work upon some branch of zoology or paleontology published during the year as in the opinion of the . . . judges in that regard shall be the most meritorious and worthy of honor. The medal and diploma and surplus income shall not, however, for more than two years successively, be awarded for treatises upon any one branch of either of the sciences above mentioned. . . . The medal and diploma and surplus income may be conferred upon naturalists of any country and . . . no person acting as judge shall be deemed on that account ineligible to receive this annual gift . . . if, in the opinion of his associates, he shall . . . be entitled to receive them.

The treasurer of the academy reports that the Elliot Fund has increased since the original donation of $8,000. The best idea of the kind of work for which this award was designed may be gathered from the résumé of previous awards:

1917, Frank M. Chapman for his "Distribution of bird life in Colombia."

1918, William Beebe for his "Monograph of the pheasants," Volume I.

1919, Robert Ridgway for his "Birds of north and middle America," Part VIII.

1920, Othenio Abel for his "Methoden der paleobiologischen Forschung."

1921, Bashford Dean for his "A biblography of fishes," Volume I.

1922, William Morton Wheeler for his "Ants of the American Museum Congo expedition."

1923, Ferdinand Canu for his "North American later Tertiary and Quaternary Bryozoa."

Unlike other awards, the Elliot Medal is always for a special piece of research in zoology or paleontology completed and published in the year for which the award is made. The committee particularly desires that nominations shall be received for foreign as well as for American work during the year 1924. Recommendations should be accompanied by a printed copy of the research submitted for consideration.

Henry Fairfield Osborn,
Chairman, Committee on Award

SCIENTIFIC NOTES AND NEWS

Presentation of a bust of Admiral George Wallace Melville will be made to The American Society of Mechanical Engineers by a group of his friends at the annual business meeting of the society, on December 3.

M. Paul Painleve, president of the French Chamber of Deputies, will retain his chair of mathematics at the University of Paris. He is now giving lectures at the university on two days a week.

B. D. Saklatwalla, of the Vanadium Company of America, will be presented with the Grasselli Medal at a meeting of the American Section of the Society of Chemical Industry in December.

President L. H. Baekeland, of the American Chemical Society, appointed Atherton Seidell as the society's delegate at a meeting of the Netherland Chemical Society and the Netherland Society of Chemical Industry, held on October 25, 1924, to commemorate the fiftieth anniversary of the foundation of stereochemistry by Van't Hoff and Le Bel.

Dr. William M. Jardine, president of the Kansas Agricultural College, has been appointed by President Coolidge an additional member of the agricultural commission.

Howard M. Gore, of West Virginia, has been appointed by the president to be secretary of agriculture to succeed the late Henry C. Wallace. Mr. Gore, who has been acting secretary since the death of Mr. Wallace, wlil serve until March 4, when he becomes governor of West Virginia.

J. A. Carroll, fellow of Sidney Sussex College and Isaac Newton Student of Cambridge University, has been appointed assistant director of the Solar Physics Observatory, at Cambridge, in succession to E. A. Milne, appointed professor of applied mathematics at the University of Manchester.

Dr. Friedrich Pashen, director of the Institute of Physics of the University of Tübingen, has been appointed president of the National Institute of Physical Technology, Berlin.

The Pasteur Institute in Paris has instituted a section of soil bacteriology with S. Winogradsky, for-

merly director of the Institute of Experimental Medicine in Petrograd, in charge.

GUY C. ROBINSON, formerly employed as research chemist for the United Bakeries Corporation at Chicago, has been made director of the department of research and analysis of that organization.

OSCAR R. SMITH has resigned as chief chemist for the Atlas Steel Corporation, of Dunkirk, N. Y., and is now testing engineer and chief chemist with W. B. Coleman and Company, of Philadelphia, Pa.

THE Hammermill Paper Company has renewed its fellowship at Yale University to John L. Parsons, for the session 1924–25, in order to enable him to complete his studies on oxy-cellulose under the guidance of Professor Harold Hibbert.

ERNEST H. VOLWILER has been elected chairman of the Chicago Section of the American Chemical Society, to succeed Gerald L. Wendt, who resigned to become dean of the School of Chemistry and Physics at Pennsylvania State College.

THE Rockefeller Foundation gave a dinner on November 18 at the Commodore Hotel, New York, to forty-eight physicians and scientific men of New York and European countries. Dr. J. A. Ferrell, director for the United States of the International Health Board of the Rockefeller Foundation, presided, and John D. Rockefeller, Jr., made a brief address. The guests of honor were Dr. Thorvald Madsen, president of the Health Commission, League of Nations; Dr. G. Tryde, director of the State Board of Health of Denmark; Dr. H. M. Gram, chief medical officer of the Health Department of Norway; Dr. L. S. Fridericka, professor of hygiene at the University of Copenhagen; Dr. Andreas Diesen, assistant director of the Health Department of Christiania, Norway; Dr. A. V. Hill, Jodress professor of physiology at University College, London.

DR. GEORGE H. SIMMONS, of Chicago, who is traveling in England, was entertained at a dinner at the Oriental Club in London on October 20, by Dr. Aldo Castellani. He also was the guest of honor at the annual council dinner of the British Medical Association on October 22. Dr. Simmons has left for India, where he expects to stay until March.

DR. H. M. GRAM, chief medical officer of the Health Department of Norway, and Dr. Emile Brumpt, of the Academy of Medicine of Paris, are visiting the United States as guests of the International Health Board of the Rockefeller Foundation.

PROFESSOR T. RAFALSKI, who is in charge of the forestry department of one of the universities of Poland, has been making an inspection tour of the Adirondacks, for the purpose of studying New York State's methods of forest protection work.

DR. FILIPPO SILVESTRI, of the Agricultural School at Portici, Italy, has been appointed entomological explorer for the California Agricultural Station, with headquarters in Hongkong, China, in connection with a search for beneficial insects to strengthen the biological control of injurious insects in California.

DR. WILLIAM W. CORT, of the School of Hygiene and Public Health of Johns Hopkins University, delivered a series of lectures recently at the University of Illinois on research problems for the department of zoology. On November 10 he spoke on "Problems of the Orient for parasitologists"; on November 11 on "Hookworm investigations in China under the auspices of the International Health Board"; on November 12 on "Parasites and parasitic diseases in China." The lectures were illustrated and embodied the results of Dr. Cort's sabbatical year in China as lecturer at the Peking Union Medical College and special investigator for the International Health Board.

DR. WILLIAM J. MAYO will speak at the University of Michigan on December 5, as the first speaker of the endowed lecture course which he gave the university last June.

DR. ARTHUR L. DAY, director of the Geophysical Laboratory of the Carnegie Institution, Washington, gave an illustrated lecture entitled "Some causes of volcanic action," before the Columbia University Chapter of the Sigma Xi, on November 19.

DR. EMERY R. HAYHURST, professor of hygiene, Ohio State University, Columbus, delivered the DeLamar lecture at the Johns Hopkins School of Hygiene and Public Health, November 3, on "The occupational aspects of common disabilities."

THE regular meeting of the California section of the American Chemical Society occurred on October 3, when Professor G. N. Lewis, of the University of California, addressed the members, his subject being "The molecule as a magnet." A special meeting was held by the section on October 11, on which occasion Dr. E. C. C. Baly, professor of inorganic chemistry at the University of Liverpool, spoke on "Photosynthesis of naturally occurring compounds."

DR. JOHN I. HUNTER, professor of anatomy, University of Sidney, Australia, lectured under the joint auspices of the department of anatomy of the University of Chicago, and the Institute of Medicine of Chicago, on November 10, on "The anatomy and physiology of the sympathetic nerve supply of striated muscle."

W. H. EMERSON, PH.D. (Johns Hopkins), dean of the Georgia School of Technology and professor of

chemistry, connected with the institution since 1888, has died at his home in Atlanta, aged sixty-five.

A. M. BURROUGHS, assistant professor of horticulture in the College of Agriculture at the University of Missouri, was killed in an automobile accident on September 8.

DR. JOSEPH MOELLER, emeritus professor of pharmacognosy in the University of Vienna, died on October 4, aged seventy-seven years.

DR. D. VAN DUYSE, professor of pathologic anatomy, University of Ghent, and author of works on embryology, ophthalmology and anatomy, has died.

DR. WILLIAM ROSTER, professor of geology at the University of Geneva, has died at the age of sixty-eight years.

DR. BERGONIE, roentgenologist of Bordeaux, France, recently died from burns received in the pioneer days of X-ray experimentation.

SHORTLY after the death of Sir William Macewen, as we learn from the *British Medical Journal,* a committee was formed at a meeting held in Glasgow to promote a fitting memorial to his life and work. At this preliminary meeting, which was attended by representatives of the University of Glasgow, of the British Medical Association, by many of Sir William Macewen's old assistants and students, and by numerous members of the medical profession, an executive body representative of different interests was appointed. It has now been decided that the fund should be applied to three main purposes, in the following order: (1) The provision of a bust of Sir William, by a sculptor of eminence, with a replica for Sir William's family; it is intended that the bust shall be placed in the university. (2) The establishment of a memorial lecture, to be known as "The Sir William Macewen Lecture," to be delivered annually or biennially; it is intended that it should be not merely a memorial oration, but should deal with any branch or aspect of surgical science. (3) The foundation of a Macewen medal or prize in surgery, to be awarded annually; it has not been decided yet whether this shall be assigned to the class of surgery at Glasgow University or shall be given a wider application. The committee aims at obtaining a fund amounting to £3,000, and towards this about £1,000 has already been received.

THE United States Civil Service Commission announces the following open examinations: December 10, scientific aid to fill vacancies in the Bureau of Standards, at an entrance salary of $1,500 a year; December 16, junior mathematician to fill vacancies in the Coast and Geodetic Survey, at an entrance salary of $1,860 a year; January 7, junior physicist to fill vacancies in the Bureau of Standards, at an entrance salary of $1,860 a year.

THE executive committee of the Chemical Society of Washington has authorized the appointment of a committee on chemical education. The functions of this committee will be: (a) To prepare a recommendation regarding the best procedure to organize the chemical teachers of Washington and vicinity. (b) To discuss such plan with the executive committee and the local section of the American Chemical Society on November 13, the annual meeting of the society. (c) To take proper steps to put the approved plan into effect. The committee consists of L. W. Mattern, McKinley High School, *Chairman;* James F. Norris, National Research Council; Charles E. Munroe, Bureau of Mines; G. L. Coyle, Georgetown University; Elizabeth R. Gatch, Central High School; N. E. Gordon, University of Maryland, and Frank Suter, Eastern High School.

DR. W. A. ORTON, formerly pathologist in charge of the office of cotton, truck and forage crop disease investigations, Bureau of Plant Industry, U. S. Department of Agriculture, resigned this position on November 1, to accept appointment as scientific director and general manager of the Tropical Plant Research Foundation, with headquarters at Washington, D. C. Announcement is also made of the following appointments in the Tropical Plant Research Foundation, to conduct research work on sugar cane problems in Cuba: Professor D. L. Van Dine, entomologist, formerly specialist in extension entomology, Pennsylvania State College; Dr. James A. Faris, pathologist, formerly national research fellow at the Brooklyn Botanic Garden; Dr. R. V. Allison, chemist and soil biologist, formerly engaged in post-doctorate study at Rothamsted, England; Mr. C. F. Stahl, assistant entomologist, formerly assistant entomologist, Bureau of Entomology, U. S. Department of Agriculture, and Dr. Marion N. Walker, assistant pathologist, formerly junior pathologist, office of cotton, truck and forage crop disease investigations, Department of Agriculture.

THE Society of American Bacteriologists will hold its annual meeting this year in Washington, D. C., on December 29, 30 and 31. The morning meeting on December 29 will be a joint session with Section N of the American Association for the Advancement of Science.

A STATE museum conference was held at the Milwaukee Public Museum on November 17 and 18 to organize a Wisconsin State Museum Association. The conference was called by Charles E. Brown, curator of the State Historical Museum, Madison; Dr. S. A.

Barrett, director of the Milwaukee Public Museum; Dr. George L. Collie, curator of the Logan Museum at Beloit College; Ralph N. Buckstaff, secretary of the Oshkosh Public Museum, and Arthur C. Neville, superintendent of the Green Bay Public Museum. About 60 Wisconsin museums of various kinds were represented, including state museums, city museums, county museums, college and state normal museums. The association will be along the same line as those in New England, New York and other states, and will be affiliated with the American Association of Museums. The program included demonstrations by the Milwaukee Museum of ways of collecting, installing and recording material. The two principal speakers were Lawrence E. Coleman, secretary of the American Association, New York City, and Professor Fay Cooper Cole, who is giving a course in museum methods at the University of Chicago.

Eight new mountains have been found and ascended in the Cariboo Range of British Columbia by Professor R. T. Chamberlin, of the University of Chicago's department of geology, and Allen Carpe, of New York, who have recently returned from Canada. One of the mountains is among the highest in the Canadian Northwest. They also located the headwaters of the Thompson and Canoe Rivers, and they are the first white men ever to note the glacial sources of these two mountain streams. They camped on the rocks as high as 10,000 feet, using a special powder for fuel.

The Experiment Station Record states that a decree authorizes the establishment in the State of Rio Grande do Sul of a central agricultural experiment station to supplant three small stations at Bagé, Alfredo Chaves and Caxias. The new station will have sections devoted to the culture of wheat, oats, barley, flax, sugar and oil-bearing seeds. Another decree of the same date provides for the establishment of a similar station at Ponta Grossa in the State of Paraná to study and give practical demonstrations regarding the cultivation of wheat, rye, oats, barley and flax. The new stations will be located in the center of the best cereal district of Brazil, and illustrate the policy of the government to stimulate cereal production. At the present time, wheat and wheat flour are among the most important imports, wheat production having been practically at a standstill for several years and negligible in quantity. Special efforts are also being made to increase the production of barley, rye and oats.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of the late Ellis Wainwright, of St. Louis, Washington University will receive the residue of his estate, which it is estimated will amount to approximately $600,000.

Mr. and Mrs. George W. Todd have given to the University of Rochester $100,000, bringing the contributions to the university's proposed $10,000,000 fund to $3,845,998.23.

Ground has been broken at Columbia University for buildings for the departments of physics and chemistry. Actual erection will start in December or January. The nine-story $900,000 chemistry building, primarily devoted to laboratories, will house the offices of the dean and professors and a few class rooms. The $1,250,000 physics building will have twelve stories with an observatory on the roof for students of astronomy.

Dr. John H. Musser, Jr., assistant professor of medicine at the University of Pennsylvania School of Medicine, Philadelphia, has been appointed professor and head of the department of medicine at Tulane University School of Medicine, to succeed Dr. George S. Bel, resigned.

Dr. H. C. George, who recently resigned from the United States Bureau of Mines, has been appointed professor of petroleum engineering at the University of Oklahoma. The subject of petroleum engineering will rank with other major engineering courses in the university.

Dr. H. N. Calderwood, Jr., has been appointed assistant professor in chemistry at the University of Wisconsin, in place of Dr. Glenn S. Skinner, who has resigned.

Professor Rudolf Pummerer, of the University of Greifswald, has been called to the chair of chemistry in the University of Erlangen, vacant by the retirement of Professor Otto Fischer.

Drs. Haruo Hayaski and Kenzo Sudo have been appointed deans of the Tokyo Imperial University Medical College and the Kanazawa Medical College, respectively.

DISCUSSION AND CORRESPONDENCE

A MISLEADING DESIGNATION

A recent number of the "Public Health Reports" (May 9, 1924, page 1074) contains a report of a case of *Dibothriocephalus latus* (*Diphyllobothrium latum*). To the scientific name is appended in the text as a popular designation the name of Broad Russian Tapeworm under which alone the parasite is listed on the cover. While this popular designation is not new it does not seem to have gained wide currency and before it should become incorporated into the literature as an accepted common name I wish to record a protest against its use.

The older authors have all of them referred to this well-known species either as the fish tapeworm or broad tapeworm of man and it is so recorded in all American literature until relatively recent times. Corresponding terms are also utilized by various authors in European languages, and it is unfortunate that any one should regard it necessary to make a change from these two early descriptive names which have been so widely introduced and under which this species is generally so well known. For many reasons, geographic names are not advisable designations for species and the one utilized here is distinctly open to criticism on all the grounds that may generally be urged against such designations as a whole.

The designation is in the first place incorrect since the species in question is well known to have almost a cosmopolitan distribution. It is to be sure limited by certain dietetic relations, *viz.,* the consumption of fish, which varies widely but is definitely connected with the proximity of water bodies yielding a fish food supply that is utilized by a considerable percentage of the adjacent population. Ordinarily the species is listed as common around the Baltic and North Seas and around certain inland water bodies. Many cases on record come from Scandinavia, Switzerland, France, Japan and from the German Baltic provinces as well as from other Baltic provinces which for the most part are now independent and not included in Russia. Consequently such a designation for this species as Russian is scientifically misleading.

One might also rightly object to geographic terms since the species in question has no relation whatever to the nationality involved in the name. Earlier views regarding racial immunity or susceptibility to helminthologic infection have been shown to be largely if not entirely incorrect. Proper consideration for international relations as well as for the scientific factors involved would hence naturally lead to the elimination of such a term and to the utilization of one free from the unfortunate connotation.

Of all the cases of the broad tapeworm on record in this country the large majority are reported from Scandinavians, Germans, Finns and the parasite is in no wise definitely related to the Russians. It is to be hoped that a designation thus definitely misleading may be avoided by writers in future.

HENRY B. WARD
UNIVERSITY OF ILLINOIS

ULTRA-VIOLET LIGHT AND THE ANTI-NEURITIC VITAMIN

IN recent numbers of SCIENCE and elsewhere observations have been recorded indicating an intimate connection between the antirachitic property of foodstuffs and ultra-violet radiation. Especially in view of the finding that foodstuffs may be rendered antirachitic by ultra-violet radiation, it may be of interest to record the result of an experiment performed a year ago in connection with the effect of ultra-violet light on the antineuritic food factor. In this case it was found that the antineuritic factor was destroyed completely by radiation for a few hours of an aqueous yeast extract which was exposed to the rays of a quartz mercury arc lamp in a layer 2–3 mm deep. Both the irradiated and non-irradiated extract were tested by feeding to pigeons otherwise maintained on a white rice diet.

R. R. WILLIAMS
ROSELLE, NEW JERSEY

STIMULATION OF SPORE GERMINATION BY CO_2

DURING a study of Basisporium dry rot of corn, it was found difficult to germinate the spores of the causal organism, *Basisporium gallarum,* in the usual water drop cultures. The spores of the fungus germinated poorly or not at all when placed in drops of water and held at optimum temperature. In the presence of plant tissue, however, where such tissue is not in contact with the culture drop, profuse germination takes place. Brown[1] described this phenomena in connection with his studies on spore germination but offered no definite explanation of it.

In the case of *B. gallarum* the stimulating effect is produced not only by aromatic fruits and flowers but by leaves and green stems or any fresh cut plant tissue. The general effect of plant tissues suggested carbon dioxide as a possible agent in the stimulation of spore germination. This assumption was strengthened by failure of the spores to germinate in the same chamber with plant tissues if barium hydroxide solution in sufficient amounts was also present. Moreover, while air passed over cut plant tissue, introduced into the same chamber with the spores, strongly stimulates germination, if passed through barium hydroxide before entering the spore germination chamber, no germination results. In all cases where barium hydroxide was used with plant tissue, a heavy precipitate of the carbonate was produced.

The agency of CO_2 in the stimulation of germination of the spores of *Basisporium gallarum* was further demonstrated by the use of washed CO_2 from a generator. The gas in small amounts, from 1 to 5 per cent., stimulated the spores in water drop cultures to profuse germination, while control cultures failed to germinate.

L. W. DURRELL
IOWA AGRICULTURE EXPERIMENT STATION,
AMES, IOWA

[1] Brown, William. "Studies in the physiology of parasites," IX, 1922, *Ann. Bot.*, 36, 285–300.

FALL OF A METEORITE IN MINNESOTA

THE following account of the fall of a meteorite near Parker's Prairie, Minnesota, was obtained from eye-witnesses.

On Thursday, July 17, about noon, between 12:15 and 12:30, Mr. C. U. Carlson and family, together with his neighbor, Mr. T. W. Sterriker, were at the dinner table near a double window facing the north, when an "awful explosion" was heard, and looking out of the window they saw through the trees the water in the small shallow lake about 300 feet away splash to a height of forty or fifty feet. The boys and Mr. Sterriker rushed out and observed the high waves which formed a "cross bar" effect out about seventy-five feet from shore. This effect was evidently due to wave interference, as the fall occurred in a small bay.

The fall was also seen from a point on the opposite side of the lake, about a quarter of a mile away, by Mr. Sterriker's seven-year-old daughter, who thought it was an aeroplane. She described it as coming from the west or northwest.

The witnesses agree that there was bluish smoke and steam formed over the lake by the fall, both of which drifted quickly away in the southwest breeze.

Mr. Carlson's farm is in Ottertail County, Section 10, T. 131 N, R. 37 W.

During the days and evenings immediately following the fall, several men enthusiastically spent hours trying to find the meteorite without success. The writers spent the afternoon of August 9 prodding the thick mud from the end of a rowboat, with a long steel rod, with no better luck. The water is low, its surface being about five or six feet above a sand hard pan in the locality of the fall. Over the bottom of the lake basin is a layer of soft mud from three to five feet deep.

WILLIAM O. BEAL
GEORGE A. THIEL
THE UNIVERSITY OF MINNESOTA

SCIENTIFIC BOOKS

L'Hérédité. By E. GUYÉNOT, Paris, Doin, small 8vo, 463 pp., 1924. *Heredity and Eugenics*. By R. R. GATES, New York, MacMillan, 288 pp., 1924. *Outline of Genetics, with special reference to plant material,* M. C. COULTER, Chicago, University of Chicago Press, 211 pp., 1924.

THE modern science of genetics, now rounding out its first quarter of a century, has brought out such an astonishing array of new facts that the need of text-books and general treatises, which shall render this new knowledge available for schools and the general reader, has become obvious. We have them now in most of the European languages. In Germany, besides Baur's work written from the botanical standpoint, there is the new "Einführung" of Goldschmidt. Scandinavia has several small treatises. The French have built the new facts into their temple of science very slowly, waiting to be shown that they will weather the disintegrating tendencies of further critical work. Now we have in the "Bibliothèque de Biologie générale," which Professor Caullery is editing, a book on genetics in which Lamarck's name is hardly mentioned, and the inheritance of acquired characters is not referred to except to ridicule it. This is Guyénot's book "L'Hérédité." Starting with the view that heredity is a broader topic than Mendelian crossing, the author, after a brief introduction, discusses in three livres the laws of hybridization, the chromosome theory of heredity and Mendelian anomalies and problems of heredity (including human heredity). The facts of modern genetics comprised in these three parts are familiar enough to American geneticists. They are set forth in the brief and clear style characteristic of the best French professors. In one respect the author takes a broader view than some in insisting that both cytoplasm and nucleus cooperate and interact in heredity; although we are ignorant of just how. The author denies that we possess a sufficient comprehension of the mechanism of heredity.

The text-book of Gates is somewhat different from Guyénot's and very different from the classic treatise of Bateson or the text-book of Punnett, to mention only his own countrymen. He states in the preface that he was impelled to write the book by his interest in eugenics and, accordingly, except for two introductory chapters on heredity in general, the book is devoted to abstracts of the literature of discoveries in the fields of physical and mental characters of man, closing with a chapter on social and world aspects of eugenics. In the latter chapter is a discussion of miscegenation and problems of population. As indicated above the body of the book comprises abstracts of scores of papers, classified under the various topics, with frequent reference to findings in other vertebrates. While the data are compiled with no little skill, still the result is not all it might be in two respects, *viz.,* completeness of acquaintance with the vast literature and criticalness in working over that literature. But, doubtless, it may be maintained with much reason that it is still too early, because of incompleteness of data, to write a critical and philosophical history of human heredity.

The text-book of Coulter is, unlike the others considered in this review, chiefly limited to a particular kind of material, namely, plants and mostly the

higher plants. However, the author has become more catholic in the selection of materials in this revision than in the original edition of "Plant Genetics." That title he recognizes as too narrow, inasmuch as "the fundamental principles of inheritance are the same in the two groups of organisms" and "it is necessary to use many of the results of animal investigation." The book is designed to be used as an elementary text, yet is provided with material for advanced students. It is one of the first elementary texts that has been issued; the "essentials" reduced to 200 pages. It is accompanied by numerous new diagrams. Altogether it is clearly the work of a teacher with hereditary capacity and long experience and will do much to help train a new generation of genetical students. As compared with Castle's "Genetics and Eugenics" (of which a new edition has just appeared) it is more of an elementary text rather than a compendium. It is less dominated by the author's viewpoint based on the personal researches of a lifetime; it lays more stress on plants and does not consider human material at all.

C. B. DAVENPORT

COLD SPRING HARBOR, N. Y.

SCIENTIFIC APPARATUS AND METHODS

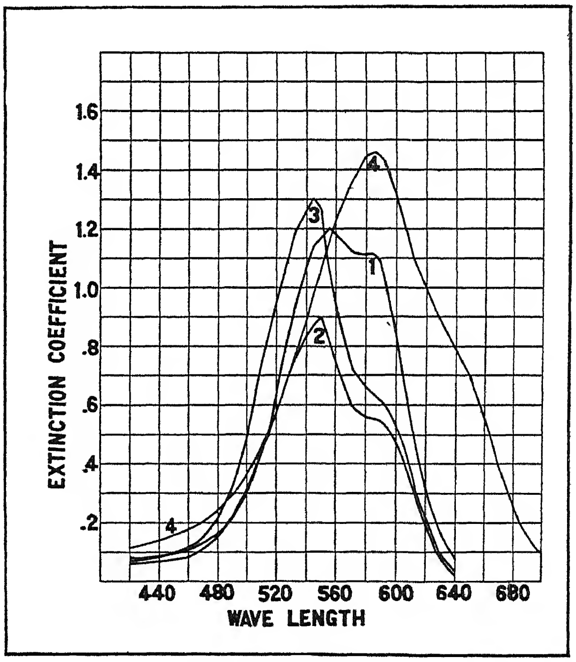
THE INVESTIGATION OF BIOLOGICAL STAINS IN THE COLOR LABORATORY OF THE BUREAU OF CHEMISTRY[1]

THE chemical investigation of stains in the Color Laboratory is undertaken in cooperation with the Commission on Standardization of Biological Stains, of which one of the authors is a member.

In determining the dye content of samples, both the spectrophotometric method and titration with titanous chloride have given general satisfaction, while alternate methods of analysis have been developed in specific instances. In establishing the essential chemical character of samples or determining, so far as is possible, the identity and relative proportions of all coloring matters present in appreciable quantities, spectroscopic examination has proved particularly convenient and effective.

An examination of twenty-five samples of basic fuchsine showed a wide range of chemical variation, attributable to differing views of manufacturers as to the relative effectiveness of the three basic fuchsines listed by Schultz for general or specific application. The relative degree of methylation of these dyes constitutes the principal factor of chemical variation for the determination of which reliable spectrophotometric methods have been developed. Collaborative investigations of the staining characteristics of a variety of typical fuchsines, of which the identity has been established in this manner, are now being undertaken. The results obtained in these tests should do much to dispel the present uncertainty as to the specific utility of the different constitutional types of the stain.

The preliminary examinations of the samples of cresylecht violet used by Williams in his investigation on the staining of tissues,[2] and of another sample of Grübler product proved illuminating. The Grübler stains contained variable proportions of a red and of a violet dye, whereas the same violet dye, free from admixture with other dyes, was present in the American stain. It was clearly demonstrated that the effective staining agent in the application of the stain made by Williams was the violet dye. It re-



CRESYLECHT VIOLET

(1) = Williams' original Grübler stain—100 mg. dye per liter.

(2) = Williams' second Grübler stain—100 mg. dye per liter.

(3) = A third Grübler stain —100 mg. dye per liter.

(4) = Williams' American (No. 1197)—100 mg. dye per liter.

Solvent = buffered aqueous sol. (pH 6.5) 1 cm. layer.

[1] 98th contribution from the Color Laboratory, Bureau of Chemistry, Washington, D. C.

[2] *J. of Lab. and Clin. Med.*, Vol. VIII, No. 4, January, 1923.

mains for further investigation to determine whether the red dye, which is the principal constituent of the imported products examined, is of use in any connection.

Between forty and fifty samples of methylene blue have been examined. The great majority have proved to be of normal chemical type. In a number of instances, however, the presence of considerable quantities of dyes other than methylene blue was established. The spectrophotometric evidence indicated that such products were probably prepared from methylene blue by treatments similar in type but milder in degree than those employed in the manufacture of certain American methylene violets and azures. Since these products have proved to be excellent stains, the determination of the constitution of the component dyes and their preparation in a pure state will be undertaken as opportunity is afforded.

The most difficult phase of the work before the laboratory is the differentiation of products of normal type in which the minor variation involved is in respect to the subsidiary dyes produced by the side reactions which are unavoidable in the manufacturing processes. It remains to be demonstrated whether or not such minor variations affect the performance of stains appreciably.

Many samples of methylene blue, basic fuchsine, acid fuchsine, eosine and safranine and a few samples of methyl green, cresylecht violet and thionine have been examined. Of these over thirty have been of pre-war *Grübler* origin and about one hundred of recent American manufacture. The investigation has been sufficiently comprehensive, accordingly, to provide an adequate basis for a comparison of the chemical characteristics of pre-war stains and the corresponding products now marketed in this country.

In general, the American stains have contained from two to four times as much dye as the corresponding pre-war products. The commission has made a reasonably high dye content one of their specifications for stains which shall be suitable for their "certification." Apart from protecting the economic interests of purchasers, such specifications will promote uniformity in performance.

Although it has not been considered necessary to carry out a systematic determination of the insoluble matter in the stains examined, it has been noted repeatedly that pre-war stains contained quantities of insoluble residue (principally tarry material) which were abnormal, even if the deficiency in dye content was not taken into consideration.

Several pre-war stains contained dyes of types which precluded the possibility of natural origin in the manufacture of the stain, in quantities which were too large to have resulted from accidental contamination in mixing and grinding and too small to make it probable that they were added with the intention of modifying the staining characteristics of the stain. Since products of this type are of frequent occurrence in textile dyes, with which it is of the greatest importance to maintain precise standard shades, the conclusion that the stains in question were prepared from textile products appears warranted.

Large proportions of auramine were found in two pre-war safranines and large proportions of fluoresceine in two pre-war eosines. Several pre-war methylene blues were of the abnormal character to which reference has already been made. In each instance the labeling of these mixtures was identical with that of other pre-war products of normal chemical characteristics. The propriety of marketing mixtures of dyes may be questioned, unless their components are not available in relatively pure form. The label should invariably warn customers of the character of such products.

Many of the earliest stains of American origin were reasonably satisfactory, and the general improvement in the subsequent output has been marked. Most American manufacturers have given the commission active cooperation in its effort to develop superior products.

It is the aim of the commission to provide a certification of satisfactory stains (whether of American or foreign origin) which will insure products of relatively excellent and uniform chemical characteristics, as well as of tested performance. It is believed that such a certification will make feasible a corresponding standardization in technic and result in establishing biological staining on a more satisfactory basis.

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SPECIAL ARTICLES

THE EFFECTS OF DISLOCATION OF THE EYE UPON THE ORIENTATION OF THE GOLDFISH (Carassius Auratus)[1]

THE eye, the semicircular canals and the lateral line have been invoked by various biologists to explain the facile orientation of the fish. The following experiment was devised in order to determine, if possible, what part vision performs in this orientation. The eyes being normally in the lateral position, it was

[1] Preliminary Report from the Hull Physiological Laboratory of the University of Chicago.

thought that by placing them in different positions the orientation would be altered if indeed vision is an important factor.

Large goldfish (*Carassius auratus*) were chosen for the work because of their ready availability and unusual vigor. These animals were in excellent condition throughout the experiments.

An artificial orbit was made for the left eye in the top of the cranium just to the left of the midline by the use of a large dental drill. A narrow canal was cut through the bone connecting it with the natural orbit through which the nervous and vascular connections passed when the eye was slipped into its new orbit. In this way the eye may be readily dislocated within a few minutes without obvious injury to it or its connections.

No detectable abnormalities in the animal's behavior could be noticed. Its orientation and locomotion were unchanged. The right eye was removed a week later. We were thus able to produce a real experimental cyclops. For the first week its behavior was quite as before. After about the tenth day, however, the animal was observed to orient itself tilted a little toward the left side whether swimming or at rest. The tilting increased constantly during the next four weeks after which time it assumed a position with its dorsoventral axis 45° to the left of the vertical. The vision of the animal was regularly tested during this period and found to be very good. If a small rod was slowly moved toward the eye the animal quickly turned aside and avoided it constantly.

A photograph was taken of the animal at this time and the eye replaced in its own orbit. The following day the fish was swimming quite vertical without any observable tendency to tilt toward either side. Its vision and orientation were observed the following two weeks and no abnormalities observed. At no time during the experiment did the animal show any abnormalities other than the tilting; circus movements, etc. being entirely absent.

We feel justified, therefore, in concluding that the visual function is an important element in the normal orientation of this species, visual impulses being apparently able to counteract the controlling influence of the labyrinth.

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THE DECOMPOSITION OF SALICYLIC ALDEHYDE BY SOIL ORGANISMS[1]

THIS aldehyde was obtained from several plants, *e.g., Spirea ulmaria* and other species of Spirea by Pagenstecher[2] in 1835. It was reported in *Crepis foetida* by Wieke in 1856. It is formed by the oxidation of salicon which occurs in willow (Salix) and bridal-wreath (Spirea).

Salicylic aldehyde was first isolated by Shorey[3] from the garden soils of the Mount Vernon estate, and later found in widely separated soils by Schreiner and Skinner.[4] They found that this aldehyde is injurious to wheat plants. Ten parts per million in solution cultures caused a reduction of growth of 31 per cent. in the first six days. The plants were killed in solutions containing 50 parts per million. Other crops were affected similarly, though in some instances higher concentrations were necessary to cause injury. In soil cultures 25 parts per million of salicylic aldehyde was injurious to wheat seedlings.

In order to determine the ability of soil organisms to decompose salicylic aldehyde 27 pairs of cultures were prepared with the usual precautions. After incubating at room temperature for two weeks observations and tests were made. These showed a slight growth of bacteria in five different cultures, but decomposition of salicylic aldehyde in none of them.

Sub-cultures were made from each soil culture to make sure that there had been no mistake in observation. None of these yielded growth of bacteria, and none showed decomposition of salicylic aldehyde. In the growth of the bacteria in the few soil cultures mentioned above the bacteria doubtless used organic matter contained in the soils instead of salicylic aldehyde as the source of carbon.

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[1] Published with the permission of the director of the Alabama Experiment Station.

[2] Pagenstecher, Report, *Pharm.*, 49, 337, 51, 364.

[3] Shorey, E. C., "Some organic soil constituents," Bulletin 88, 13 pp., *Bureau of Soils*, 1913.

[4] Schreiner, O., and J. J. Skinner, "Occurrences of aldehydes in garden and field soils," *Journal Franklin Institute*, 329–343, September, 1914.

THE AMERICAN CHEMICAL SOCIETY

SECTION OF HISTORY OF CHEMISTRY

F. B. Dains, *chairman*

Lyman C. Newell, *secretary*

The one hundred and fiftieth anniversary of the discovery of oxygen: EDGAR F. SMITH. (Note: Dr. Smith was unavoidably absent. The secretary read Priestley's account of the discovery of oxygen from an original copy of "Experiments and Observations on Air," Vol. II, pages 33–35, and emphasized the importance of this discovery to American chemistry by reading an ex-

tract from a paper on "The founders of chemistry in America." There were on exhibition an autograph letter of Priestley written in 1775 about this discovery and sending his "respects to M. Lavoisier," pictures of Priestley's house and church in England, and his home in Northumberland, Pa., apparatus shown there when American chemists visited his home in 1874 and rare books and pamphlets written by Priestley.)

Chemistry in the early days of Rensselaer Polytechnic Institute: W. P. MASON. The institute was established in 1824, and Amos Eaton was the principal and the first teacher of chemistry. He established the system of "student lectures." Among his students who became noted as teachers and chemists were John Torrey, Chester Dewey, Mary Lyon (who founded Mount Holyoke College), Douglas Houghton, John L. Riddell, Ebenezer Emmons, Michael Tuomey, Ezra Carr, Eben N. Horsford (who started the Lawrence Scientific School at Harvard) and James C. Booth (who was president of the American Chemical Society in 1883–84).

Some famous chemists at Union College: EDWARD ELLERY. The men who established and developed chemistry at Union were Rev. Thomas C. Brownell and Jonathan Pearson in the earliest days (1814–1850), Charles A. Joy and Charles F. Chandler in the middle days (1850–1865) and Professor Perkins in the later days (1865–1902). Joy and Chandler gave the department a great impetus through their studies in Germany.

Early history of chemistry in Buffalo: A. P. SY. Among the names connected with the early chemical industries are Schoellkopf, Cornell, Giesecke, Hamlin and Rumsey. Teachers of chemistry date back to the establishment of the Medical School of the University of Buffalo in the early forties, and the names to be remembered are Hadley, Doremus and Witthaus. At their Central High School William H. Pitt not only taught chemistry, but also applied it by working out a method for removing sulphur from Ohio crude petroleum.

Egyptian chemistry as pictured on the walls of tombs. (Lantern): ARTHUR W. TAYLOR. Wall pictures from the tombs at Thebes and Beni Hassan were shown. The chemical operations included dyeing, metallurgy of gold, weighing gold, making jewelry, blowpipe working with furnace, pottery, brickmaking, glass blowing and baking (the royal bakery of Rameses III). The dates ranged from 3500 to 1450 B. C. The paper contained all known references to pictures so far found.

Some old chemists. (Lantern): EDGAR F. SMITH. (Not presented.)

Sylvius de la Boë: LYMAN C. NEWELL. A Frenchman by descent, a Dutchman by adoption. Born in 1614, died in 1672. Graduated at Basel in 1637, and soon after went to Amsterdam where he practiced medicine and studied chemistry. He was a professor in the University of Leyden from 1658 till his death. He founded a chemical laboratory at Leyden. He taught that chemistry is the foundation of physiological processes. Like his contemporaries he used powerful medicines. He believed in the transmutation of metals.

Benjamin Hale, chemist and college president: LYMAN C. NEWELL. Benjamin Hale was professor of chemistry at Dartmouth College from 1827 to 1835. He was asked to resign because he changed from a Congregationalist to an Episcopalian. In a letter to the trustees he pointed out that the shortcomings of the department were due to their limited knowledge of the place of chemistry in a liberal education. He was elected president of Hobart College, Geneva, N. Y., in 1837, and remained there till his death in 1863.

Paul Ehrlich: ARTHUR S. WOOD. This paper covers briefly the life work and important contributions of Ehrlich to chemistry, bacteriology and medicine and discusses incidentally some of the personal qualities of this remarkable man.

A. von Baeyer: JOHN F. CONN. An exhaustive paper on the life and work of Baeyer, especially his contributions which led to fundamental progress in industrial organic chemistry.

Alexander von Humboldt in some of his relations to chemistry: C. A. BROWNE. Alexander von Humboldt, the naturalist and explorer, was an intimate friend of nearly all the leading European chemists of his time. His assistance to various young chemists, as shown by the personal testimony of Liebig and Dumas, helped them on the way to fame and success. Humboldt's great interest in chemistry is shown not only in the pages of his most famous work, "Cosmos," but in the account of his travels to equinoctial America and his "Essay upon the kingdom of New Spain." His statistical and metallurgical study of gold and silver production in Spanish America is one of the best chemical economic surveys ever made. The state of chemical knowledge in Spanish America at the time of Humboldt's visit was good and he calls particular attention to the fine equipment of the Mexican School of Mines and the excellent work of its director, Andres del Rio, the discoverer of vanadium. Humboldt's scientific studies of the sugar, cochineal, cocoa, indigo, drug, starch, dyewood and other industries of New Spain are invaluable contributions to the history of chemical technology. In the field of sanitary chemistry Humboldt held that malaria and the various contagious tropical fevers were produced by atmospheric miasmata emanating from decaying vegetable matter and consisting of gaseous "ternary or quaternary combinations of nitrogen, phosphorus, hydrogen, carbon and sulphur." He criticized in facetious style the septous gas theory of contagion held by Dr. S. L. Mitchell, of New York. Humboldt's attitude toward the chemical arts of the aboriginal American Indians was always sympathetic and we owe to him the preservation of many facts of scientific interest which otherwise would have been lost.

SCIENCE

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CONTENTS

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MUSCULAR ACTIVITY AND CARBOHYDRATE METABOLISM[1]

THE PROBLEM: INTRODUCTION

IT has long been discussed whether the breakdown of carbohydrate, rather than of other substances, is primarily responsible for the provision of energy in muscular contraction. It is known and accepted that work may be done, in the general melting-pot of the body, by the use of any kind of foodstuff. We are now concerned, however, specifically with the *primary* process of muscular contraction. In the complete chain of processes involved in long-continued exercise, this primary process may be disguised, or even apparently obliterated, by simultaneous transformations which take place between the different food constituents. Considering the internal combustion engine, it is obvious that petrol and benzole may be used indiscriminately for providing power and driving the machinery. In the same way, however, as we ask whether carbohydrate is the specific fuel of muscle, or whether fat may be used in an identical manner, so we might query whether petrol or coal can be used in an internal combustion engine. The obvious answer is that coal must be prepared beforehand by distillation, before it can be used in the engine, while petrol can be used directly; and that in the preparation of coal to form benzole for use in the engine, a considerable proportion of the energy of the coal is wasted, as regards its work-producing power. Putting our problem in terms of the modern theory of muscular activity and assuming that the initial process in contraction—that which causes the mechanical response—is an entirely non-oxidative one consisting of the formation of lactic acid from glycogen, we are asking now whether the recovery process by which the lactic acid is restored to its precursor can go on at the expense of *any* oxidation, or *only* of that of carbohydrate. *May the recovery mechanism, so to speak, be driven by any kind of combustion, as a steam engine may be, or is it necessary specifically to combust carbohydrate?*

THE RESPIRATORY QUOTIENT

It has long been known that the respiratory quotient during prolonged steady exercise is not unity. It varies with the diet. That, however, does not an-

[1] A lecture delivered at the request of the Mayo Foundation, at Rochester, Minnesota, and at the Universities of Iowa, Nebraska, Minnesota, Wisconsin and Michigan, in October and November, 1924.

swer our question. Carbohydrate may be used exclusively in the muscular process of breakdown and recovery, but as fast, or almost as fast, as it is used up it may be restored, in the general metabolism of the body, by the breakdown of some other substance, *e.g.*, of fat. The combustion of carbohydrate, followed by the reformation of carbohydrate from fat, would affect the respiratory quotient in a manner exactly similar to the direct combustion of fat.

Mechanical Efficiency on Different Diets

The beautiful and very convincing experiments of Krogh and Lindhard (1), published in 1920, showed with little possibility of doubt that the combustion of carbohydrate has some special connection with muscular activity. Employing a method where the respiratory quotient may be determined with an average error of only $\pm$ 0.002, measuring the cost of doing a given amount of work of moderate intensity in a highly trained and carefully observed and calibrated subject, and varying the substances metabolized by varying the diet during and before the experiment, they found the cost of work (*i.e.*, the total amount of energy used in doing a given amount of work) to be a linear function of the respiratory quotient, falling as the respiratory quotient rose. Of the total energy used in any effort, granting that the respiratory quotient be correctly measured, the fraction which is derived from fat may be shown to be a linear function of the respiratory quotient. I say intentionally, *"if the respiratory quotient be correctly measured"*: we will discuss later the variations of respiratory quotient produced by lactic acid in the body, during and after severe muscular work. Such variations, however, do not affect Krogh and Lindhard's experiments, where the exercise was moderate, requiring only about one liter of oxygen per minute, and continued for a long time. If now we assume that carbohydrate oxidized is utilized directly for work, or (more accurately) for recovery from work, and fat only after "conversion" involving metabolic processes and loss of energy, the cost of work should be a linear function of the respiratory quotient—as Krogh and Lindhard found. As the mean of a long, careful and carefully weighted series of observations, which give one all the impression of extreme reliability, they found, assuming carbohydrate to be utilized directly for the production of work (or, as I should rather say, for carrying on the recovery process) that fat may be so used only after "conversion" involving a 10 per cent. loss of energy: in modern terms, the recovery process is 10 per cent. less efficient when fat is oxidized than when carbohydrate is oxidized. This suggests strongly that the primary breakdown is of carbohydrate, and that fat is used only in a secondary manner, *e.g.*, to restore the carbohydrate which has disappeared. These experiments of Krogh and Lindhard are particularly valuable since they were made on intact animals, namely, healthy men, and involved the complete process in the whole mechanism.

Lactic Acid

The most important line of evidence in this connection starts from the work of Fletcher (2) and of Fletcher and Hopkins (3), leading to that of Meyerhof (6), Embden (4), (5), and others. The phenomena of muscular fatigue are known to all, both personally and in the laboratory, as also is the effect of oxygen thereon. An isolated muscle stimulated in nitrogen soon fatigues and never recovers: an isolated muscle stimulated in oxygen may go on contracting for days. These observations of Fletcher's led to the lactic acid story (3). In an isolated muscle at rest and without oxygen the acid accumulates slowly, faster at a higher temperature; with a sufficient supply of oxygen it remains at a low value. Stimulation also will produce lactic acid: in oxygen this lactic acid is removed. According to Embden and his coworkers, the origin of this lactic acid in the muscle is a hexose di-phosphoric ester. They succeeded in isolating an osazone similar to that described by Harden and Young in the case of yeast. This hexose phosphate is presumably a very unstable substance; it has not been isolated from muscle; its amount can be estimated only indirectly and on certain assumptions. Embden regards it as the immediate precursor of the lactic acid which appears, though Meyerhof's experiments make it clear that it is glycogen which bears a quantitative relation to lactic acid. The amount of Embden's "lactacidogen" present in a muscle at any moment must be estimated by measuring the inorganic P_2O_5 immediately after, and one or two hours after, the fine division of the muscle: the increase in the P_2O_5 is supposed to represent the "lactacidogen" which has broken down. The evidence, though indirect, appears to yield results so definite that it is difficult not to believe that hexose phosphate is somehow intimately concerned with muscular activity. After severe muscular work, following a dose of phloridzin in rabbits, and after strychnine convulsions in rabbits and in dogs, there is a marked diminution in the "lactacidogen" present in their muscles. It is interesting too to record that, according to a communication of Robison and Kaye to the British Biochemical Society, the injection of insulin causes an increase in the "lactacidogen" of muscle. It must be admitted, however, that the rôle of the hexose-phosphate is not yet clear.

THE CARBOHYDRATE ORIGIN OF LACTIC ACID

It is very natural to attribute a carbohydrate origin to the lactic acid which is concerned so intimately with muscular contraction. By the fermentation of various types of carbohydrate lactic acid may be formed, and Meyerhof (6) has shown by a series of direct experiments, confirmed by independent methods at Cambridge by Foster and Moyle (7) that when lactic acid appears in muscle, whether from anaerobic conditions or from fatigue, an equivalent amount of glycogen disappears; in the converse process of recovery when the lactic acid is removed, glycogen reappears, not this time in equivalent amount but with a 25 per cent. loss, which is accounted for by the oxygen used and the heat produced in the recovery process. In the isolated muscle, therefore, there can be no doubt that lactic acid has a carbohydrate origin and is restored to carbohydrate in recovery, a fraction of it only being used in the oxidative processes required to drive the recovery mechanism. That this recovery reversal of the glycogen-lactic acid breakdown is, at any rate in isolated muscle, carried out at the expense of energy derived from carbohydrate oxidation, is made the more certain by Meyerhof's observation that *the respiratory quotient of recovery is unity*. Moreover, in the isolated muscle there is no sign of any diminution in the fat contained in the muscle, as was shown by Winfield (8) and confirmed to some degree by later and more severe experiments at Manchester (unpublished). The total amount of glycogen present in a muscle is adequate to account for the whole of the energy used in the most prolonged series of contractions that that muscle is capable of carrying out in oxygen, even under the most favorable conditions (9). It is possible, of course, that no transformation or combustion of fat is possible without the cooperation of other organs (*e.g.*, the liver) or of the body as a whole. We shall see later how far this objection applies. In the isolated muscle, however, we may safely assert that the only processes which are known to occur, the formation of lactic acid from glycogen in the initial phase and the removal of the lactic acid, coupled with the oxidation of a small amount of it in the recovery phase, involve nothing but reactions with, and by, carbohydrate.

PANCREATIC CONTROL

Azuma and Hartree (10) have shown that insulin has no effect whatever on the recovery oxidation in isolated muscle, and Foster and Woodrow (11) that it has no effect on the lactic acid formation in resting surviving muscles. In intact animals under insulin treatment glycogen tends to disappear from the muscles (Dudley and Marrian (12)) possibly partly to form a hexose phosphate, certainly not to form lactic acid. Moreover, Himwich, Loebel and Barr (13) have found that lactic acid formation in the diabetic individual is just as much the basis of muscular contraction as in the normal. This has been confirmed independently by my colleagues Long, Lupton and Hetzel (hitherto unpublished), not only in the case of the formation of lactic acid but in that of its removal in recovery. Apparently lactic acid is just as much involved in the mechanism of contraction in the diabetic as in the normal man. That there is, however, some factor in the pancreas concerned in the carbohydrate metabolism of muscle was shown by preliminary observations of Hopkins and Winfield (14) in 1915, who found that pancreas preparations have an inhibitory action on the formation of lactic acid in minced muscle. Apparently in the pancreas there is a substance, stable at high temperatures, which has a controlling action on the carbohydrate breakdown of muscle. This substance is not a ferment, and may be present in commercial pancreas preparations several years old. Foster and Woodrow (11) followed up this clue and established the fact that there is an inhibitory agent for the anaerobic lactic acid formation in muscle, which may be isolated from the pancreas and produces considerable inhibition even under conditions leading usually to the maximum lactic acid formation. This substance is not insulin, which has no such effect. They suggest that this new unknown substance has a specific controlling function on the carbohydrate metabolism of muscle, and that carbohydrate metabolism may be grouped into two great subdivisions, that of the body as a whole under the control of insulin, and that of muscle, to some degree under the control of this new pancreatic hormone.

ANALOGOUS METABOLISM IN OTHER CELLS

An interesting side-line from Foster and Woodrow's experiments arises when we remember that, according to the modern view of muscle, the basal metabolism of the intact animal is in large part the recovery from the resting lactic acid production of its muscles. This new pancreatic hormone might be expected, therefore, to control the basal metabolism, and possibly we may find in it a means of antagonizing an over-activity of the thyroid—though that is guesswork. Foster and Woodrow, on the basis of these experiments, have put forward the theory of carbohydrate metabolism (just referred to) to which, on quite other grounds, those who have been working on muscular activity have been inevitably reduced, namely, that the carbohydrate metabolism of muscle is a different thing from that of the body as a whole. That this carbohydrate metabolism of muscle, how-

ever, involving lactic acid, is not unique is indicated by many lines of evidence. For example, Stephenson and Whetham (15) have found that *Bacillus Coli,* in a medium containing glucose, uses oxygen if it can get any, and produces CO_2 and lactic acid: in nitrogen, CO_2 and lactic acid are produced up to a certain limit, the fermentation being a self-inhibited one: in oxygen less lactic acid is produced, more CO_2 is liberated and more oxygen is used. Apparently these organisms, in the presence of sufficient oxygen, can break down glucose completely to CO_2 and water. In the absence of sufficient oxygen they break it down, as does muscle, to lactic acid. If suspended in a medium containing no glucose but ammonium lactate, in the absence of oxygen they can do nothing; in the presence of oxygen they can produce CO_2 and use up oxygen, as does a muscle carrying out its recovery process.

Again, Warburg (16), using the delicate gas-manometer method of Barcroft, has measured the CO_2 produced and the oxygen used by various tissues suspended in a glucose-Ringer solution. Some of the CO_2 is produced by combustion of carbohydrate, some is driven out from preformed bicarbonate by acid formation. Expressing as "extra CO_2" the amount of CO_2 produced in excess of that derived from the oxygen used in burning carbohydrate, the "extra CO_2" is a measure of the lactic acid produced by the fermentation of glucose, that is, of the carbohydrate broken down, while the oxygen used is a measure of the carbohydrate oxidized. Normal tissues give a ratio, (extra CO_2)/O_2 of practically zero. Cancerous tissues from a rat, however, give an average ratio of 3.6: human cancerous tissues give a ratio usually from 2 to 4, but varying over wide limits. In normal tissues, therefore, the oxidative process of glucose metabolism is effective and the fermentative process is small: in cancerous tissues the oxidative process is ineffective and the fermentative process is large. If Warburg is correct, the cancerous tissue *is like a muscle in which the recovery mechanism has almost broken down.*

GLYOXALASE

In all tissues of the body except the pancreas Dakin and Dudley (17) found a ferment, glyoxalase, which is capable of transforming methyl glyoxyl $CH_3.CO.CHO$ into lactic acid $CH_3.CHOH.COOH$. This ferment is inhibited by excessive acidity, that is, by an accumulation of the product of its own activity. It is present also in the blood of diabetic persons and in the blood and liver of diabetic dogs. An extract of the pancreas inhibits this reaction, and Dakin and Dudley have called this inhibiting substance *antiglyoxalase.* Antiglyoxalase is destroyed by heat, and on other grounds also it would appear not to be the same as the pancreatic hormone of Hopkins and Winfield, and of Foster and Woodrow. It is conceivable that the normal path of carbohydrate metabolism may lie through the formation of lactic acid by glyoxalase from methyl glyoxal; unfortunately, except for the presence of this potent enzyme glyoxalase, there is little evidence, either for or against this theory.

THE FATE OF LACTIC ACID IN RECOVERY

The fate of lactic acid, which is an undoubted intermediary in the breakdown of carbohydrate in the muscle, was long debated. Its removal during recovery, as established by Fletcher and Hopkins, was naturally credited at first to a simple process of oxidation. There were, however, certain fundamental difficulties about this to which there seemed to be no answer. The heat of combustion of glycogen, from which it is formed, is, according to Slater (18), 3,836 calories per gram, when the glycogen is in its fully hydrated form, as it occurs in solution in the muscle: that of dissolved lactic acid is 3,601 calories (Meyerhof), leaving a total energy for the transformation of the one to the other of only 235 calories. This small quantity then is the total energy available in the initial transformation of glycogen to lactic acid, while in the complete process, if the lactic acid were then oxidized, 3,836 calories would be liberated. The mechanical efficiency, therefore, of muscular contraction, supposing *the whole* of the initial energy were turned into work, could not exceed 6 per cent. Values of 25 per cent. have been found in the case of man. Actually the initial liberation of heat[2] per gram of lactic acid formed in muscle is larger than 235 calories, being about 296 calories. The difference has been attributed by Meyerhof to the neutralization of the acid by buffered alkaline protein salts inside the muscle fiber. There is no doubt that the acid is neutralized as soon as it is formed, since the hydrogen ion concentration does not rise appreciably. Moreover, there is not enough phosphate or bicarbonate present in the muscle to neutralize all the lactic acid formed. Neutralization by phosphate and bicarbonate liberates only a little heat, while that by buffered protein salts liberates a large amount. Even assuming, however, that 296 calories are liberated in the initial phase and that the whole of this energy is turned into work, if the lactic acid were then oxidized the efficiency could still be only 8 per cent. Clearly the lactic acid is not oxidized.

It has proved possible, moreover, to measure the total amount of heat liberated in the recovery process

[2] Total anaerobic (370 cals.) less delayed anaerobic heat (74 cals.)

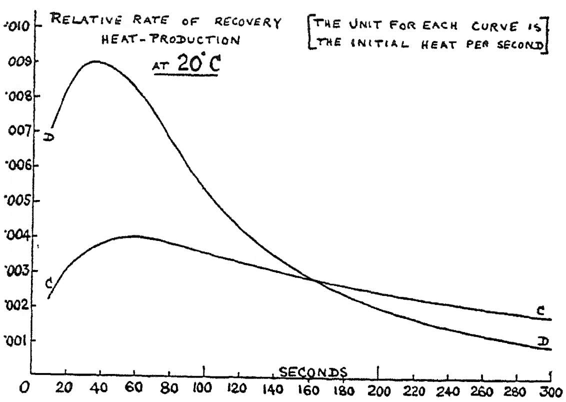

FIG. 1. Delayed heat-production of an isolated muscle in the presence of oxygen: C .03 sec. and D .20 sec. tetanus. (Hartree and Hill, 1922.)

(fig. 1), which in the latest and most careful measurements has come out almost exactly equal to the total heat liberated in the anaerobic phase. Thus, in the formation and the subsequent removal of a gram of lactic acid only 740 calories of heat are found, which is only about one fifth of what would occur if the lactic acid once formed from glycogen were subsequently oxidized *in toto*. Apparently of every 5 molecules of lactic acid removed in the recovery process only one is oxidized; the remaining four are restored to the place, or as the substance, from which they arose. There is no possibility of any error in the general conclusion to be drawn from these heat measurements: the difference to be explained is far too large; probably indeed the heat measurements provide us with the most accurate means of determining the "efficiency of recovery," as we may call it (or, in Meyerhof's term, the "oxidative quotient"), that is, the ratio of the amount of lactic acid removed to that oxidized in its removal. The best value to assume seems to be, in frog's muscle, about 5 to 1, and this is confirmed, as I shall show later, by two independent lines of experiment on man. This conception of the fate of lactic acid has been confirmed by Meyerhof's direct observations of the glycogen restored and the lactic acid lost during the recovery process. All lines of experiment, therefore, on the isolated muscle indicate about the same value for the efficiency of recovery. There is no doubt that one must regard lactic acid in muscle as being not so much the fuel as part of the machinery.

THE RECOVERY PROCESS

Consider now the recovery process in further detail. In the whole animal, without special precautions which we shall discuss later, it is not easy to isolate the recovery process from other events in the animal at large. In the isolated muscle the chemical method of investigation is not sufficiently analogous to what happens during normal existence, since the oxygen supply is cut off from its normal route by the cessation of the circulation, and (having to depend upon diffusion) is necessarily inadequate. *The oxidative removal of lactic acid in isolated muscle stimulated to severe fatigue has to take place under conditions of severe oxygen want, and is a very protracted affair.* The speeds, for example, at different temperatures can not be compared since they depend simply upon the rate at which oxygen can pass in, by diffusion from outside. Fortunately another method is available which, compared with the chemical method, is of surpassing sensitivity, namely, that in which the heat-production is measured (19). Myothermic technique is so sensitive, and so well under control, that it is possible to measure and to analyze the course of the heat production for many minutes after only a single twitch of the muscle, in which case the total amount of energy involved and the total amount of oxygen used are so small that the amount of the latter originally dissolved in the fluid of the muscle is more than adequate to account for the whole of the oxidation carried out. We are independent therefore of the oxygen supply, and can study the speed and magnitude of the recovery process in a muscle provided with an entirely adequate amount of oxygen.

We find, when we stimulate a muscle, that there is initially a large production of heat, which must be attributed to the formation of lactic acid from glycogen and its subsequent neutralization. Then commences a slow process of recovery, in which heat is liberated continuously for many minutes until the muscle has been completely restored to its initial condition. The heat production rises rapidly at first, attains its maximum in a few seconds to half a minute, and then slowly falls to zero again, along a curve which is roughly exponential. This curve of recovery heat production is the thermo-dynamic outline of the recovery process, into which fuller details must be drawn later by biochemical analysis. The speed of the process depends on temperature: it is increased very largely by a rise of temperature, decreased by a fall, so that in a frog at 0° C. complete recovery, even from a few hops, must take an hour or more! Extrapolating the results on frog's muscle to the temperature of the human body, the recovery process from moderate effort should be nearly complete in two to three minutes, given an adequate supply of oxygen: as indeed we find it to be. Its speed depends also on the size of the initial breakdown of which it is the result, not only absolutely

but relatively. Its speed is affected by the hydrogen ion concentration, being diminished by a rise and increased, up to a certain limit, by a fall, beyond which, however, it remains constant. Carbon dioxide, in concentrations of 10 to 15 per cent., produces a considerable fall in the rate of the recovery process, working much more quickly than do other acids, presumably because CO_2 can more easily penetrate the muscle fiber. The effect of hydrogen ion concentration on the speed of the recovery oxidation is analogous to that on the speed of autoxidation of glutathione or cystein. The total extra amount of heat liberated by oxidation in the recovery process is almost exactly equal to that set free in the anaerobic breakdown alone.

THE "ACCUMULATOR FUNCTION" OF MUSCLE

These facts have led us to the conception of the muscular machine as an accumulator of energy, analogous in its way to a lead electrical accumulator. The initial discharge, which may take place at a high rate, depends in no way on the oxygen supply: the final recharge, which is slower, depends directly on oxidation. In voluntary muscle all oxidation must be regarded as recovery oxidation: even though oxidation takes place during continuous exercise, and appears to be contemporary with the exercise, it must really be regarded as recovery from previous elements of the exercise.

It is probably not true to assert that in all organs and tissues oxidation is recovery oxidation. For example, Starling and Verney have recently shown that in a kidney secreting normally the administration of KCN, which abolishes oxidation, produces immediately a change in the secretion, making it in all respects similar to a filtrate from the blood. Apparently "knocking out" oxidation immediately "knocks out" the capacity of the tubule cells to perform their normal function. It is probable that the same immediate dependence upon oxidation exists in other tissues. Possibly those organs, in which sudden and violent activity may be required at a moment's notice and which are stimulated to activity through nerves, tend to act, as does voluntary muscle, like an accumulator: while slower tissues, in which rapid and violent response is not so necessary, may be content to remain dependent for their energy on oxidation, as does an internal combustion engine.

THE RECOVERY PROCESS IN MAN

The conception that all muscular oxidation is really recovery oxidation has produced an extensive change in outlook in regard to respiratory experiments on man. One of the fundamental difficulties of a large animal is the supply of oxygen to his tissues. When muscular exercise starts the oxygen intake rises, attaining a maximum in man in two to three minutes. Respiration and circulation have to be worked up and the recovery process has to get under way. Muscles, however, are required for immediate and violent use, and even the maximum intake of oxygen, which in athletic men is about 4 liters per minute, can provide energy only for comparatively moderate exercise; in order to attain even that maximum a period of two to three minutes is necessary. Actually the human body is capable of exerting itself nearly ten times as violently as it could possibly do were it obliged to obtain all its energy immediately by combustion. Just as a lead storage cell is found to accumulate sulphuric acid in the plates during its activity, so a muscle is found to accumulate lactic acid: just as the storage cell has its sulphuric acid removed from plates to solution during recharging, so the muscle has its lactic acid restored to its precursor in recovery. With this conception it is of interest to study the process of recovery not only in isolated muscles but in man, and in the last few years this study has proceeded a considerable way, especially by the efforts of my colleagues Long and Lupton. Lupton, alas, has not lived to reap the reward of his devoted work, or to realize the full importance of what he did.

LACTIC ACID IN MAN

Lactic acid may be studied directly in man by its estimation in blood removed in the usual way from a vein. During muscular activity the lactic acid in the blood rises, attaining finally, if the exercise be continued long enough, a maximum characteristic

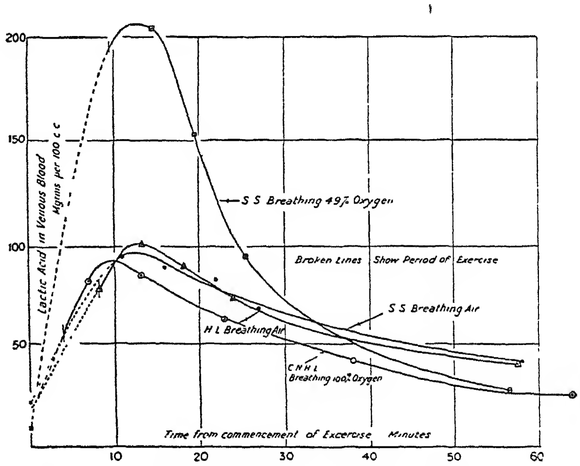

FIG. 2. Lactic acid in human blood after severe muscular exercise; two experiments in air, one in 49 per cent. oxygen, one in 100 per cent. oxygen. Note that the recovery process is not quite complete at the end of the time shown in the diagram. (Hill, Long and Lupton, 1924.)

of the effort made. After awhile the lactic acid distributes itself by diffusion equally in all tissues which are directly in contact with the blood stream. During recovery this lactic acid disappears, in a period depending upon the severity and duration of the preceding exercise but not exceeding, in normal man, about 90 minutes. (Fig. 2). The removal of lactic acid from the blood, which is a sign of its preceding removal from the muscle, is produced by oxidative processes occurring in the latter. These oxidations can be studied by ordinary respiratory methods, employing the Douglas bag technique. The initial phase of the recovery process, which is rapid and is concerned with the oxidative removal of the acid in the muscles where it was formed, can be followed by means of collections in a series of bags. The recovery oxidation falls rapidly, and after moderate exercise reaches zero in a few minutes. If, however, the exercise was severe, the lactic acid will have had time to escape from the muscles into the blood, and into other tissues in contact with the blood, and a second phase of recovery will occur, the removal of lactic acid which has escaped. This second phase may be very protracted and last as long as 80 minutes. The total oxygen used in the recovery process in this way we have named (20) the *"oxygen debt at the end of exercise."* Assuming, what may be shown to be very nearly true, that it is all used in the oxidative removal of lactic acid, and employing a value of 5.2 to 1 for the efficiency of recovery, we may calculate from the oxygen debt the lactic acid present in the body at the end of exercise. We find that *3 grams* or more of lactic acid may be liberated *per second* in the muscles of a powerful man, and that the body is able to tolerate an amount up to a *total of 130 grams.* The oxygen debt may attain a value of 18.7 liters!

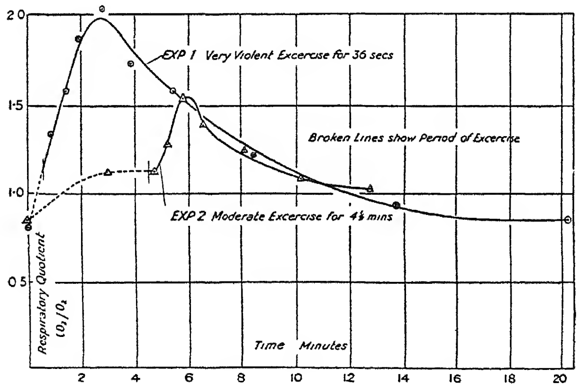

FIG. 3. The respiratory quotient during and after muscular exercise. These figures show the initial phase of recovery only. The final phase is shown in fig 4. (Hill, Long and Lupton, 1924.)

This lactic acid formation, therefore, in the human body is not a small or unimportant factor in muscular exercise; it is the keystone of the whole structure and has a large, indeed a preponderant, effect on the respiratory quotient (21). The respiratory quotient varies in a striking manner, up and down, during the onset of severe exercise and in recovery from it. At first it rises (fig. 3), attaining a value up to 2, during and immediately after the phase of lactic acid liberation, and while the respiratory center is still endeavoring to cope with the increased hydrogen ion concentration of the tissues. Before the hydrogen ion concentration of the body can have returned to its previous resting value an amount of CO_2 must be driven off equivalent to the lactic acid still present. After this previous level of the hydrogen ion concentration has been attained, which happens several minutes after recovery has commenced, the lactic acid continues to decrease and CO_2 has to be retained by the body, since otherwise the latter would become far more alkaline than previously. In the later stages of recovery the CO_2 retained is a measure of the lactic acid removed and very low values of the respir-

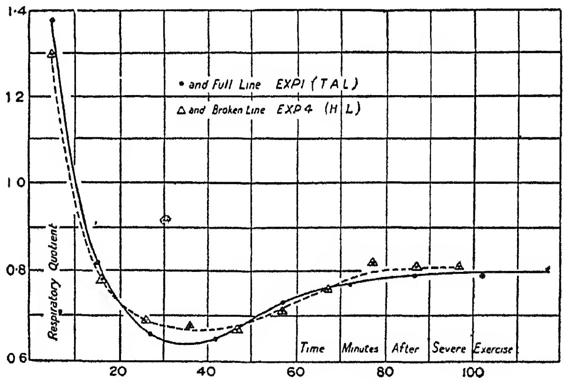

FIG. 4. The respiratory quotient after severe muscular exercise. Note that in the later phases, while carbon dioxide is being retained to compensate for that initially driven off, the respiratory quotient falls to a very low level, returning to its final value at about 80 minutes. (Hill, Long and Lupton, 1924.)

atory quotient may be found, down to 0.6 (fig. 4). Assuming this CO_2 retention to be a measure of the lactic acid removed, and the oxidation in excess of the basal value a measure of the lactic acid oxidized, we may determine in man the efficiency of recovery by respiratory methods, and its value comes to about 5 to 1, the same as in isolated muscle. Another method may be used in estimating the same quantity in man. If the lactic acid found in blood be assumed, in the later stages of recovery, to be uniformly distributed in all the soft tissues of the body which are in immediate contact with the blood stream, we

may calculate by two observations of the blood over any interval the total amount of lactic acid removed, and from the excess oxygen used in that interval we may again determine the ratio of lactic acid removed to lactic acid oxidized. We find as before a value of about 5 to 1, so that in the complete and intact animal the mechanism of recovery appears to be the same as in the simple isolated muscle.

The Use of the Respiratory Quotient

These large variations in the respiratory quotient, during severe exercise and in recovery therefrom, show how necessary it is to exercise the greatest possible precautions if we wish to draw any conclusions from the respiratory quotient as to the substance being oxidized. Such precautions were taken in the experiments of Krogh and Lindhard. The exercise must be moderate and very long continued, and the whole condition of the subject, particularly the hydrogen ion concentration of his tissues, must be "steady." Then only are deductions reliable: *otherwise the value of the respiratory quotient tells us more about the fluctuations of lactic acid in the body than about the nature of the metabolism.*

The Oxygen "Requirement" of Exercise

When muscular exercise commences the oxygen intake rises to a value which is either the equivalent of the exercise, if the latter be moderate, or is the maximum characteristic of the individual subject, if the exercise be severe. In the latter case the exercise can be continued only for a time, the lactic acid accumulates, fatigue comes on, and the muscles finally are incapable of further effort. The oxygen intake is a measure of the severity of the exercise *only* if the latter be (a) sufficiently protracted to enable a steady state to be attained and (b) sufficiently gentle to ensure that there is not a constant accumulation of acid leading to an oxygen debt. Hence by a study of the oxygen intake and the CO_2 output we can never really determine the nature of the primary oxidations of muscular activity, since the exertion must be continued for a long time until the body and all its processes are in a steady state, and the primary reactions of muscular recovery may then be masked by other and secondary effects. The oxidation of carbohydrate required to drive the recovery process may be confused for example with a reformation of carbohydrate from fat.

This fact and others have led us to a study of what we call the "oxygen requirement." The subject of the experiment takes exercise of any character and of any duration, the total organ used during the exercise and in complete recovery from it being measured. An initial and a final estimate of the resting oxygen consumption give us a base line from which the total oxygen consumption resulting from the exercise, during and in recovery from it, may be calculated. The measurement of the oxygen requirement is valuable, since it can be made in the case of any type of exercise, *e.g.,* walking up a single flight of stairs, or in very violent exercise which could not be continued long enough to make a measurement of the oxygen intake possible or useful. It may be a valuable criterion of the mechanical efficiency of work, etc. The oxygen requirement for a short element of exercise is always a measure of the total amount of energy required by the body for that exercise, assuming, as we shall see below, the energy value for oxygen corresponding to the oxidation of carbohydrate.

The R. Q. of Exercise and Recovery

Much greater interest attaches to the respiratory quotient when we consider, not only exercise, but subsequent recovery. Taking the case of a small element of muscular exercise, such as running slowly for 30 seconds, the resting respiratory exchanges are measured carefully, both before the exercise and after complete recovery. The expired gases are collected both throughout the exercise, and during a recovery interval sufficiently long to ensure that the metabolism has returned absolutely to its initial state. The *excess* oxygen used as a result of the exercise and the *excess* CO_2 given out are then determined by analysis and calculation: *they are found to be precisely equal.* The same is true of fairly violent exercise for a short interval. In the case, however, of very violent exercise, the recovery process may be very protracted and the respiratory quotient of the excess metabolism may be less than unity. If the extra metabolism of a very long period of exercise be measured, it is obvious that the respiratory quotient will not be unity. In such a case nearly all the excess of oxygen used and of CO_2 produced by the exercise occurs during the latter, while the respiratory quotient is say 0.85. Thus, as we should expect, when a bout of exercise is increased in duration from very short to very long, the respiratory quotient of the complete cycle passes gradually, from a value of unity for the very short, to a lower value characteristic, as in the experiments of Krogh and Lindhard, of prolonged steady exercise. These results appeared first incidentally in a study of the oxygen requirement of exercise, carried out for another purpose. We noted, however, that of about twenty experiments practically all gave a respiratory quotient of the excess metabolism of about unity, the mean value being 1.03 (21). The small excess we attributed to the fact that in these experiments recovery was

not quite complete, and the small CO_2 retention of the last phase had not come within our observation. Since then my colleague Dr. Furusawa has examined the matter more carefully. His experiments (see Tables I and II) show that the respiratory quotient of the excess metabolism due to a *short element* of muscular exercise is unity. This is the case, even if the subject, having lived for several days on a diet of fat and protein, has a resting respiratory quotient of little more than 0.71 (Table II). If the exercise be prolonged the stores of carbohydrate are used up and have to be reformed by the transformation of other substances, presumably of fat; such a transformation acts upon the respiratory quotient just as though fat itself were being oxidized, so that the respiratory quotient falls. Given, however, an element of muscular exercise, so moderate in duration and severity as to produce no measurable carbohydrate lack in the muscles and no disturbance of metabolism in the rest of the body, we find that *the whole oxidative cycle of recovery is carried out at the expense of carbohydrate.*

TABLE I.—(*Unpublished experiments by K. Furusawa*)

NORMAL DIET

R. Q. of Excess Metabolism Due to Exercise

Duration or Exercise Mins.	Steps per Min.	Duration of Collection Mins.	Excess Metabolism CO_2/O_2	R. Q.
0.5	92	10	355/350	1.00
0.6	64	10	485/490	0.99
1.0	146	20	2120/2037	1.04
1.0	160	31	4185/4048	1.03
2.0	208	76	11230/10251	1.09
10	120	60	8720/8900	0.98
12	160	85	19860/18620	1.06
15	146	77	25670/25960	0.99
20	146	110	41310/42210	0.98
28	146	63	49520/52900	0.94
30	120	70	20225/20345	0.99
30	146	105	49420/56230	0.88

Not postabsorptive but several hours after a meal.
Average R. Q. resting = 0.85
Average R. Q. excess metabolism = 1.02
(Up to 30 liters O_2.)

TABLE II
(Unpublished experiments by K. Furusawa)

FAT DIET

(Bacon, Butter, Milk, Fat Chops)

R. Q. of Excess Metabolism due to Exercise

Subject	Duration of Exercise Mins.	Steps per Min.	Duration of Collection Mins.	Excess Metabolism CO_2/O_2	R. Q.	Compare R. Q. at Rest
K. F.	0.33	272	22	2733/2570	1.06	0.72
K. F.	1.0	146	20	2400/2260	1.06	0.71
K. F.	2.0	146	30	3020/2964	1.02	0.75
K. F.	4.0	146	43	10525/10822	0.97	0.78
K. F.	7.0	146	50	13730/15145	0.91	0.72
K. F.	9.0	146	100	18910/19940	0.95	0.76
K. F.	9.0	146	88	18835/20420	0.92	0.77
J. L. P.	0.4	216	22	3260/3341	0.98	0.77
J. L. P.	0.5	196	25	2132/1966	1.08	0.77
J. L. P.	1.0	146	26	3300/3345	0.99	0.73
J. L. P.	1.0	162	24	5255/5256	1.00	0.75
J. L. P.	5.0	146	35	12910/13775	0.94	0.75

Fatty diet, K. F. five days, J. L. P. 3 days, before exps.

This confirms and amplifies the experiments of Krogh and Lindhard with which we started this discussion, and makes clear how the experiments on the isolated muscle, with their indication that carbohydrate is the essential fuel of muscle, may be reconciled with the respiratory quotients obtaining in prolonged moderate exercise in man. *The primary fuel of muscle is carbohydrate: the essential element in the machinery is lactic acid, itself derived from carbohydrate.* The breakdown of carbohydrate in muscle is associated with the presence of phosphates, possibly in the form of a hexose diphosphoric ester. What the further details of the process are we do not know, but it is difficult not to believe that the utilization of fat by muscles can occur only after its previous "conversion" somewhere in the body. Even a subject suffering from severe carbohydrate want (Table II) will oxidize carbohydrate, and carbohydrate alone, in the complete cycle of reactions resulting from an "element" of muscular exercise.

A. V. HILL

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GENERAL POLICIES OF THE CARNEGIE CORPORATION[1]

DURING the year comparatively little time has been required for the study of specific new enterprises, for the obvious reason that funds were not available to finance them. As a result, the trustees have been free to devote their energies primarily to the formulation for their own guidance of a tentative body of doctrine as to the general policies of the corporation, and more specifically to a consideration of the fields in which, for the present at least, it should concentrate its efforts. Some discussion of the principles underlying these policies may be of service in making more clearly understood the problem which faces the corporation with reference to any particular grant; for this problem is not a simple one, depending wholly, or even primarily, on the merits of that particular proposal, but a very complex one, involving a number of other factors which must also be taken into account before an intelligent decision can be reached. It should be said at the outset that certain of these factors have already been dealt with in the reports of the acting president for 1922 and 1923, and that the following paragraphs are to be regarded, therefore, as supplementary to the discussions in those reports, rather than as an attempt to cover even the most important elements in this many-sided problem.

[1] From the annual report of the president of the Carnegie Corporation of New York.

It may be of interest at this point to give some indication as to the number of those who in any one year have more than a theoretical interest in these questions. Apart from the projects brought up for consideration by the members of the board itself or presented on behalf of the boards of other Carnegie enterprises, the corporation acted last year on 397 applications. Of the cases in which a budget was submitted with the application, the amount asked for came to more than $40,000,000. In only 68 cases could any grant be made, and of these 33 were renewals of grants made in former years. It would serve no useful purpose to make public a list of the projects declined, but both the applicants and the public may be assured that one and all received consideration by the executive committee, and were brought by it to the official attention of the board, the action taken in each case being made parts of its records.

Turning now to the general questions of policy to which reference has been made, the corporation has given particular attention during the year to the following: the responsibility of educational foundations to the public and to public opinion; the relation between the diffusion of knowledge and the guidance of opinion; factors affecting the limitation of program; and relations with operating agencies.

PUBLIC OPINION

It is now generally recognized that there is no fundamental distinction between the responsibilities of universities supported primarily by public taxation and those of institutions supported primarily by private endowment—both are public institutions. It must also be recognized that educational endowments such as the Carnegie Corporation are essentially public and not private enterprises. Grants made by them are matters of public concern and, other things being equal, they should involve the largest possible degree of public participation in what is recognized on all sides to be a cooperative enterprise. It will not do for those in charge of such endowments to assume that so long as their own motives are completely disinterested, criticism as to their acts and policies should be limited to the wisdom of this or that particular grant. They must recognize that doubts as to the basic social utility of these organizations have long existed in the minds of men and women regarding whose sincerity there can be no question, whatever may be said as to the amount and accuracy of their information. While, for the moment at any rate, the extraordinary results which have been achieved through the grants of these bodies, particularly in the alleviation of human suffering, have operated strongly to increase public confidence,

no one can say whether this state of mind is to be permanent. The time may well come when the possibilities of usefulness open to the Carnegie Corporation, for example, will depend in large measure upon the number and distribution of those who can testify on the basis of actual experience that the organization does not regard itself as a dominating or patronizing force in carrying forward any particular program, but merely as one factor, and not the controlling factor, in cooperative enterprises for the advancement and diffusion of knowledge and understanding among the people of the United States. It is not enough for the trustees themselves to realize that the furnishing of funds, important as it is, is secondary to the knowledge and the labor of those who actually transform an idea into a reality; there should also be at least the nucleus of an understanding public opinion on the subject.

Diffusion of Knowledge and Direction of Opinion

While it would be exceedingly difficult and not particularly profitable to draw a hard and fast line between the diffusion of knowledge and the directing of opinion, it is clear on which side of the doubtful zone between the two the interest and the responsibility of the corporation should lie. The deliberate and conscious propagation of opinion is a perfectly legitimate function for the individual, but it is becoming generally recognized that it is not the wisest use to which trust funds can be put— and this entirely apart from the question whether, in any given case, those in charge of such funds may, as individuals, be sincerely and even enthusiastically in favor of the spread of the idea in question. Surely, the discovery and distribution of facts from which men and women may draw their own conclusions offers a field sufficiently wide and sufficiently vital to the welfare of humanity.

Limitation of Program

The foregoing are but two of many elements to be considered in determining the program of such a body as the Carnegie Corporation. Offhand, an income of six million dollars a year would appear to give freedom for practically an unlimited range of interest under the provision of its charter, but after all, six million dollars makes a very small proportion of one billion, and this latter is the sum which it has been estimated the United States requires or at any rate spends each year upon its philanthropies. The corporation must of necessity restrict its angle of vision and, at the best, it can support only a very small percentage of the projects which are brought to its attention, even from among those regarding whose usefulness to humanity there can be little question. Among the other factors to which consideration must in any case be given is that of the possibility of support from other sources. It would appear to be entirely proper for the trustees to recognize that certain undertakings can look with confidence to support for their general activities from what may be called a regular constituency. A well-established college or university, for example, may turn to its own alumni, and the members of a large and rich community served by some local institution like a library, or museum, or hospital, are more and more generally recognizing their direct responsibilities to such institutions. On the other hand there are enterprises, particularly in fields where experimentation and demonstration are still needed, which can not, certainly in the earlier stages of development, call upon any particular clientele. Many of these can not be undertaken at all unless appeal can successfully be made to the custodians of relatively unrestricted funds like those of the Carnegie Corporation.

There is another side to this question of the limitation of program which is not always borne in mind. When once a foundation has contributed to one or more typical enterprises in any given field, the others in the same field naturally turn to it for aid. Obviously, if it habitually contributes to a wide range of activities, its contribution in any single field must be correspondingly reduced, and those whose applications must of necessity be declined are often severely handicapped in securing funds from other sources, due to the impression that they have been tried and found wanting by the foundation in question. That this impression may be wholly unjustified does not undo the harm. In so far as the program of a foundation is recognized as being limited—not necessarily permanently, but for the time being at any rate—to certain definite fields within which all outstanding propositions can be considered on their merits, this unfortunate situation is less likely to develop.

In 1921, sixty-seven per cent. of the number of grants made and seventy-seven per cent. of the total sum voted, outside of the appropriations to other Carnegie enterprises, were in the nature of contributions to campaigns for the general endowment or equipment of institutions or for the general support of organizations. Since that year, the tendency on the part of the corporation has been more and more to support specific projects rather than to make such general contributions. As a result, the corresponding figures for the year now under review are as follows: forty-two per cent. of the number of grants and thirty-three per cent. of the sums voted.

While the application of this policy has naturally proved disappointing to organizations now engaged

in campaigns, it is believed that ultimately it will meet with general approval. The conditions facing the institutions of learning at the close of the war, together with good times, and the habit of generous national expenditure combined to create a series of endowment and building campaigns that swept like an epidemic across the country. A similar process developed in the interest of various associations and leagues and other similar groupings, many of which came into being at about the same period. Without prejudice to the good results obtained in many instances, it must be recognized that such a system of campaigns has its obvious disadvantages. In not a few cases, the campaigns were wastefully conducted, and in others sums received were not wisely spent. Too often the raising of funds for general expenses, and particularly for promotion expenses, becomes commercialized. This type of appeal presents an additional problem from the point of view of the foundations. In so far as these organizations are attempting to concentrate their efforts within certain recognized fields, and thus obtain from their grants cumulative results within those fields, contributions for general purposes, no matter how admirable in themselves, must be recognized as weakening their power to achieve these specific results. Fortunately, however, it is sometimes possible to make a contribution which serves to help the general financial situation of the institution in question and at the same time to carry forward, under particularly favorable circumstances, the development of an idea on which the corporation is, at the moment, concentrating its attention. A case in point is that of Harvard University, referred to on page 20. Within the means at its disposal, the corporation should always be ready to take advantage of such opportunities as they arise.

OPERATING AGENCIES

The Carnegie Corporation is not in itself an operating body. It certainly was not the intention of its founder that it should become so, and it does not seem probable that circumstances will arise which will make this step desirable. To determine the fields in which appropriations may most wisely be made and to select in general terms the special projects within those fields is in itself a sufficiently heavy responsibility for the trustees.

Later on in this report, on pages 13 and 14, some discussion will be found as to the relation of the corporation to other operating agencies. Naturally, however, its relations have been closest with those operating agencies which Mr. Carnegie had himself established, particularly the five of which the active head is, under the charter of the corporation, ex-officio a member of its own board. As an evidence of the closeness of this relationship, it may be pointed out that, since its organization, in all more than $43,000,000 has been voted by the corporation to these institutions in response to requests from them. These grants have been entirely within the purposes of the corporation as conceived by Mr. Carnegie, who had the foresight to realize that conditions might arise to render insufficient the endowments he had created for these other agencies, though their endowments at the time had seemed amply sufficient for their purposes. Since his death, to mention no other factor, the world-wide reduction in the purchasing power of money would have seriously crippled the work of at least four of these agencies if the corporation had not been in a position to come to their aid.

The Carnegie Corporation does not need money from these sister institutions, but in the solution of its own problems it does need help of other kinds, as in the carrying forward of enterprises which have been initiated by it. Something has already been accomplished along these lines, as the records of annual grants will show, but the trustees might profitably consider a rather searching study as to whether the corporation has taken full advantage of the peculiar relationship to its sister institutions which it enjoys.

OTHER PROBLEMS

The above by no means exhausts the list of problems of policy, really fundamental in their nature, which must be grappled with, and there is no doubt that the two succeeding years of the period of limited resources may be devoted to study with even greater profit than the year just closed. As a single example of the questions which face bodies like the Carnegie Corporation may be taken the question of the temporary annual grant. It is often a real privilege to provide the funds which enable some enterprise of public importance to make not only an appeal but a demonstration to the public which should ultimately support it. But it is rarely, if ever, that the corporation and the beneficiaries find themselves in agreement as to when this "temporary" aid should stop. The latter are persuaded with perfect sincerity that the amount involved, while a matter of life and death to them, is negligible to the corporation. It is not realized that in the aggregate these small sums, like the slender threads by which the Lilliputians bound Gulliver to the ground, become a very serious matter. Nor is it likely to be remembered that the corporation has always before it for consideration other commendable projects which can not be launched without just such help as they themselves have enjoyed.

CONDITIONAL GRANTS

Another problem to which intensive study could profitably be given is the conditional grant. It has its obvious advantages. A relatively small sum so offered will sometimes serve as a primer to produce an explosion of generosity from other sources. On the other hand, when the conditions have to do with certain specified methods of carrying out the project, we enter on debatable ground. The ideas behind the stipulations may in themselves be admirable, but should they not, if made at all, be suggestions rather than stipulations? It may also be questioned whether in some instances a conditional offer does not put too powerful a weapon in the hands of persons perhaps not fully qualified to exercise the responsibility of using it. It would not be difficult to cite instances in which local communities, or alumni, or religious bodies, have been dragooned by the use of this weapon into making contributions beyond their means and beyond the real needs of the institution in question.

RESEARCH

The opportunities open to the corporation in the field of research have been the subject of particular study for several years, but this is a topic which is not—and never will be—exhausted. During the present year, for example, it has been pointed out to the corporation that there are really two stages in most research processes, and that they are not necessarily best carried out by the same individual or the same agency. Breaking the trail is one matter, and broadening that trail into a road is another. The latter process is largely a matter of presentation and dissemination, but none the less it contains, or at any rate it should contain, an important element in research. A study of this whole question may prove to be of especial interest to the corporation.

FREDERICK P. KEPPEL

WILLIAM HENRY EMERSON

WILLIAM HENRY EMERSON was born at Tunnel Hill, Georgia, in June, 1860. He graduated from the United States Naval Academy in 1880. Was Midshipman from 1880 to 1882 and Ensign 1882 to 1884. He then resigned from the navy to pursue special studies at the Johns Hopkins University, from which institution he received the degree of Ph.D. in 1886, having specialized in chemistry. In the same year he accepted the appointment to the professorship of chemistry at the South Carolina Military Academy, Charleston, S. C., which position he resigned in 1888 to become professor of chemistry at the Georgia School of Technology, just then in process of organization. Here he remained until the day of his death, November 13, 1924, a period of thirty-six years. During this time he saw the institution grow from the experimental stage into one of the leading engineering and technical schools of the country. To him especially is due credit for the maintenance of high standards of scholarship, which have characterized the work of Georgia Tech. By temperament and training he was especially equipped to do research work on problems in his chosen field, and longed to do so, but with characteristic spirit he sacrificed opportunity which those who knew him believe would have placed his name high in scientific achievement, in order to carry on the heavy duties devolving upon the head of a department of a growing institution, and the additional great responsibility of the deanship, which he assumed in 1910.

Dean Emerson was awarded the degree of Sc.D. by the University of Georgia in 1912. He was a member of the American Chemical Society, Society for the Promotion of Engineering Education, Phi Kappa Phi (honor society), Georgia Academy of Sciences and Alpha Tau Omega Fraternity.

He published papers covering investigations he had made in the oxidation of mesitylene, the composition of cotton seed oil and also upon the marbles, coal and corundum of Georgia.

Dean Emerson married in 1887, and is survived by two sons and his widow.

J. L. D.

NED HOLLISTER

NED HOLLISTER, superintendent of the National Zoological Park since October 1, 1916, and one of the foremost mammalogists of the world, died on November 3, following an operation.

Mr. Hollister was born at Delavan, Wisconsin, on November 26, 1876, where he received his education and began the study of zoology. From 1902 to 1909 he conducted zoological field work for the U. S. Geological Survey in Texas, New Mexico, Alaska, British Columbia, Washington, Oregon, California, Utah, Nevada, Louisiana and Arizona. In 1910 he began his connection with the Smithsonian Institution, being appointed assistant curator of mammals in the U. S. National Museum, which position he held until 1916 when he was selected for the responsible position of superintendent of the National Zoological Park, Smithsonian Institution.

In 1911 Mr. Hollister was a member of the Canadian Alpine Club Expedition to explore the Mt. Robson region of British Columbia and Alberta, and in 1912 he represented the Smithsonian Institution on the Smithsonian-Harvard Expedition to the Altai Mountains, Siberia and Mongolia. The results of Mr. Hollister's scientific work have appeared in the pub-

lications of the Smithsonian Institution and in various technical journals for many years. Besides over 100 minor papers on zoological subjects, he was the author of a number of large works, including "The Birds of Wisconsin" (1903); "Mammals of the Philippine Islands" (1911); "Mammals of the Alpine Club Expedition to Mount Robson" (1913); "East African Mammals in the U. S. National Museum" (Vol. 1, 1918; Vol. 2, 1919; Vol. 3, 1923). This last is probably Mr. Hollister's greatest contribution to science, being a complete technical account of the great collection made in East Africa by Theodore Roosevelt, Paul Rainey and other collectors.

During Mr. Hollister's term of office as superintendent, the National Zoological Park underwent a steady growth and development. Many improvements to the grounds and animal quarters were carried out and he made every effort to provide for the enjoyment and convenience of the public. During the last few years, the collection of animals in the park has been greater in numbers and in scientific value than ever before, and the number of visitors to the park has increased steadily until it reached during the past year a total of 2,400,000. It was largely through Mr. Hollister's efforts that Congress was persuaded a few years ago to provide funds for the purchase of a frontage of 625 feet at the Connecticut Avenue entrance to the park, thus insuring for the future a dignified and appropriate approach.

Mr. Hollister was a fellow of the American Association for the Advancement of Science, a member of the American Ornithologists' Union, the Biological Society of Washington (president, 1921), Washington Academy of Sciences, American Society of Mammalogists (editor of the *Journal of Mammalogy*), honorary member of the Sociedad de Estudios Biologicos, Mexico, and a member of the Cosmos Club.

He is survived by his wife, Mrs. Mabel P. Hollister, and by his mother, two brothers and a sister.

X

SCIENTIFIC EVENTS

JACQUES LOEB[1]

By the death of Dr. Jacques Loeb the world has lost one of the great men of his generation; biology has lost one of the finest intellects that has ever been devoted to this branch of science; this laboratory has lost one of its most eminent members. He stood out among his fellows as an investigator, as a teacher and as a cultivated gentleman broadly interested in all aspects of nature and all the activities of men.

[1] Minute adopted by the Trustees and Corporation of the Marine Biological Laboratory.

As an investigator he was tireless in energy, ingenious in experimentation and exceptionally gifted in insight. He lost little time on false leads, but rather blazed his trail straight into new territory and attained his objective by simple and crucial experiments.

He brought to his work a broad knowledge of related sciences. In the latest advances of chemistry and physics he was always informed, and his researches showed the breadth of his reading and the solid character of his scholarship. He had a poet's imagination held in check by practical and mathematical faculties of high order. Consequently his hypotheses were at once brilliant and founded on the best physico-chemical data available. He was ready to change his theories as new facts were discovered. He believed that explanations of phenomena must be expressible ultimately in mathematical terms. He profoundly influenced general physiology not only by his theories and experimental results but also, quite as much, by the emphasis he laid upon the quantitative method.

Professor Loeb came to Woods Hole first in 1892. The epoch-making discovery of artifical parthenogenesis was made at this laboratory. The antagonistic action of ions was demonstrated here. Many other researches which have influenced biological thought were carried on here and may be noted in the long list of papers and books which constitute his best monument. He founded the course in general physiology at Woods Hole in 1893 and directed it for several years. He was a trustee from 1897 to his death. From 1910 he directed the branch laboratory of the Rockefeller Institute in cooperation with the Marine Biological Laboratory.

As a teacher he was enthusiastic and inspiring. His lectures were in advance of the times and full of suggestions for research. With his graduate students he was helpful and friendly and at the same time critical and stimulating. Those who were his students know how enormously they profited by his inspiring personality.

As a man his interests were well-nigh universal. He found time to make himself familiar with a large literature. He enjoyed music and all the arts. He was interested in economics, sociology and government. His "Mechanistic Conception of Life" is an important contribution to philosophy and psychology.

He was a kindly man. He was a lovable man. He hated war and all sham. He had an incisive sense of humor and loved a harmless joke. He was the center of any company and he had many friends.

This is the man we have lost. Woods Hole is not the same without him, but the inspiration of his work remains in our midst.

To his family we extend our sympathy and on the pages of our records we inscribe this memorial.

THE JAPANESE EARTHQUAKE OF SEPTEMBER 1, 1923

A PRELIMINARY report by Prof. A. Imamura, the first issued by the Imperial Earthquake Investigation Committee, has been published in the *Seismological Notes* of that committee and is abstracted in *The Geographical Journal.* Most of the instruments in the Seismological Institute at Tokyo were wrecked or dismantled by the first shock. Of the whole number, only one component of one seismograph registered the movement from beginning to end, an interval of two hours and twenty minutes, but within ten minutes from the first vibrations four seismographs were sufficiently repaired to continue their useful work, and others were added in the following days. Though few recorded more than the first tremors, these happened to be the most important, for, from the direction of the earliest vibrations and the duration of the preliminary tremors, the position of the epicenter was found to be in lat. 34° 58′·6 N., long. 139° 21′·8 E., or under Sagami Bay, and the depth of the focus to be roughly 15 kms. The survey of Sagami Bay, repeated by the Imperial Hydrographic Service, showed that an area of 700 sq. kms. had been depressed on an average by 39 fathoms, and another area of 240 sq. kms. raised on an average by 45½ fathoms. These movements naturally gave rise to sea-waves, which along the shores of Sagami Bay reached heights of 8, 9 and even 12 meters, and the remarkable feature of these waves was that the directions in which they advanced showed that the largest waves came from the areas of elevation, while those that came from the areas of subsidence were comparatively small. The great earthquake came without any warning fore-shocks, though four very slight shocks were registered at Tokyo during the preceding month, all of which had origins within or near Sagami Bay. The after-shocks, as usual, were very numerous, partly on account of the large focal area, partly because the first shock was followed in less than fifteen hours by another almost equally severe in a different part of the same seismic zone. During the first month, the total number recorded at Tokyo was 1,256, of which most of the strongest took place in the Sagami Bay area, though others originated within and to the southeast of the Bo-so peninsula, and also in a district to the north of Tokyo.

THE NEW SEISMIC STATION AT FORDHAM UNIVERSITY

THE new seismological observatory at Fordham University was dedicated on October 24. The building housing the seismographs is one of the few in the world devoted exclusively to this work, and the lately acquired "Milne-Shaw" seismograph installed there is the only one of its type possessed by any Jesuit observatory. It is the third of its kind, however, to be sent to this country. The building itself was erected by William J. Spain, of New York, in memory of his son, who was a student at the university, and died during his sophomore year.

The Milne-Shaw seismograph embraces practically all the advantages of the most sensitive type of apparatus, avoiding many mechanical complications, by reason of the method of direct photographic registration which it employs to reduce the motion of the earth to a graphic form.

It is this instrument that occupies the place of importance in the new building erected at Fordham for the study of earthquakes, although the edifice also contains other piers accommodating instruments of lesser sensitivity. Mr. F. W. Sohon, S.J., who was responsible for the detailed design of the interior, took into consideration the future development of the station and the large masonry pier on which the new seismograph stands is built to hold three instruments, two of the type already explained and a third known as the "Galitzin" vertical seismograph. When the station possesses these three machines not only the distance but the actual direction and specific location of the quake can be determined from this station, unaided by data from other sources. The reason for the three machines is the recording of the motion of the earth in three different directions, or rather the resolution of the motion of the earth into three components, one instrument recording the north and south horizontal motion, a second the east and west horizontal motion and the third the vertical motion of the earth.

The pier on which these instruments are to stand reaches to a depth of twenty-five feet, and is erected on bed rock; it is freed from local and artificial disturbances by a space between it and the floor of the building. The room in which it was erected is entered only by passing through an ante-room, from which visitors may view the installation through plate-glass windows. Beyond the instrument room proper is a photographic dark room and work shop for the development and interpretation of the records.

A special thermostat automatically controls the temperature of the building, keeping constant in all weathers, to within one degree. There is also a wireless installation in the building and the time signals received twice daily from Arlington are recorded directly on the seismograms, making the determination of the arrival of a quake accurate to less than one second. Communication by cablegram has been established with Professor Turner, of Oxford University, England, so that verification of data observed at both stations may be had in the shortest possible time.

PERMANENT PROGRAM OF THE CONFERENCE ON THE UTILIZATION OF FOREST PRODUCTS

The first national conference on utilization of forest products concluded its sessions on November 21, after mapping out a permanent program and entrusting it to the central committee on lumber standards.

The program of activities as adopted calls for completion and general adoption and application of lumber standards, as recommended by the central committee; development of the application of better attention to the problems of piling, storing and drying lumber, in all its forms; wood preservation treatments; extension of use of decay prevention in pulp and pulpwood in storage; consideration of methods for arrest and prevention of decay in logs and lumber; encouragement of surveys with the object of utilizing waste products through diversified operations; development, improvement and unifying of buildings codes; improved designs of boxes and crates and other economies, and encouragement of improvements and economies by organized industrial units consuming forest products.

Lines of investigation which, in the opinion of the conference committee, require first consideration are: forest drain loss in the woods; sawmill waste and practices and machinery; best uses of so-called "inferior species"; properties of wood; a timber survey, embracing the supply, amount of land available by regions and classes of soil on which forests can now and later be grown, and the rate at which timber is now growing and the potential growing capacity of the land; wood-using industry survey; forest protection from fires, insects and tree blights, and possible use of tropical woods to supplement American high-grade hardwoods, being rapidly depleted.

The necessity of putting idle land to work in growing tree crops by the cooperation of the states with the federal government, through the medium of the Clarke-McNary Forestry Act, was pointed out.

SCIENTIFIC NOTES AND NEWS

It is announced that the University of Paris will confer honorary degrees on seven foreigners, including Dr. Charles D. Walcott, president of the Smithsonian Institution and retiring president of the American Association for the Advancement of Science.

The Holland Society of New York awarded on November 24 its gold medal for 1924 to Dr. L. O. Howard, chief of the Bureau of Entomology. This medal is awarded annually to an American for notable and distinctively American achievement in literature, art, science or public service.

Dr. John August Anderson, astronomer at the Mount Wilson Observatory, has been awarded the Howard N. Potts medal by the Franklin Institute of Philadelphia for his invention of a new form of seismograph and for his improvements in the ruling of diffraction gratings.

In addition to the award of the Darwin Medal to Professor T. H. Morgan, announced in Science last week, the president and council of the Royal Society have made the following awards: Royal Medals to Sir Dugald Clerk, for his application of scientific principles to engineering problems, particularly to the development of the internal-combustion engine, and to Dr. H. H. Dale, for his researches in pharmacology and physiology; the Copley Medal to Sir E. Sharpey-Schafer, for his valuable work in physiology and histology; the Rumford Medal to Mr. C. V. Boys, for his invention of the gas calorimeter; the Davy Medal to Professor A. G. Perkin, for his researches on the structure of natural coloring matters.

Willard C. Thompson, professor of poultry husbandry at Rutgers University, and chief of the department of poultry husbandry at the New Jersey State Agricultural Experiment Station, has been appointed director of the National Poultry Institute of England.

Dr. William F. Thompson, director of the California State Fishery Laboratories, has been appointed director of investigation for the International Fisheries Commission provided under the Halibut Treaty between Canada and the United States. The commission has invited to act as a scientific advisory board Professor N. Cobb, University of Washington; Dr. C. McLean Frazier, chairman of the zoological department of the University of British Columbia, and Dr. A. T. Clements, of the Geological Station, Nanaimo, B. C.

Dr. Wilbur A. Sawyer, assistant regional director in the east of the work of the International Health Board of the Rockefeller Foundation, has been appointed director of the public health laboratory service of the board.

Dr. P. N. Leech has been made director of the chemical laboratory of the Council on Pharmacy and Chemistry of the American Medical Association.

Dr. E. P. Cathcart, professor of chemical physiology in the University of Glasgow, has been appointed a member of the Medical Research Council, England, in the place of Professor D. Noel Paton, who has retired.

Dr. Wm. S. Jones, Ph.D. (Ohio State, '24), has joined the research laboratory of E. R. Squibb and Sons, New York.

D. H. CAMERON, of the division of physical chemistry of the Iowa State University, has resigned to accept a position with the Celite Products Company, of Los Angeles. His preliminary work will be to organize a research laboratory for the study of oil purification.

PROFESSOR A. E. VERRILL, from 1864 to 1907 professor of zoology in Yale University and since emeritus professor, sailed on October 29 for the Hawaiian Islands, where he plans to live and to continue his zoological work.

DR. THORVALD MADSEN, president of the Health Committee of the League of Nations and director of the State Serum Institute of Denmark, who has been making a six-weeks' study of public-health administration in the United States, sailed for France on November 26.

DR. CHARLES A. BAILEY, of the staff of the International Health Board, sailed on November 15 for Spain to assist the government health authorities in a survey of hookworm infection in the mines of the country.

RECENT visitors to the New York Botanical Garden include Dr. Hugo Glück, professor of taxonomic and pharmaceutical botany at the University of Heidelberg; Dr. Otto Stapf, for many years keeper of the Herbarium and Librarian of the Royal Botanic Gardens at Kew, England, and now editor of *Curtis's Botanical Magazine;* Professor C. H. Ostenfeld, director of the Copenhagen Botanical Garden, and Major T. F. Chipp, assistant director of the Royal Botanic Gardens, Kew.

G. G. SIMPSON, Othniel Charles Marsh research fellow in the Peabody Museum of Yale University, is undertaking a series of detailed studies of the Mesozoic mammals, based chiefly on that part of the Marsh Collection preserved in the Peabody Museum. It is hoped eventually to produce a monographic revision of these ancient and interesting small animals.

CAPTAIN ROBERT A. BARTLETT, Arctic explorer, who commanded the *Roosevelt* under Peary, announces that he hopes to start next spring on his three-year journey from Nome, Alaska, across the North Pole to Spitzbergen. In a boat of 400 tons, with a crew of ten men, and accompanied by two scientific men, Captain Bartlett hopes to realize his project, first announced two years ago, of drifting with the ice floes from the Bering Straits and across the Pole between Spitzbergen and Greenland on the northern coast of Norway.

COMMANDER BRUNS, German aviator, who in 1919 announced plans for a Zeppelin expedition to the North Pole, is visiting Christiania as the guest of Dr. Fridtjof Nansen, who is reported to have agreed to accompany him when he puts the plan into operation. The expedition will be a scientific one, and is not intended to compete with that of Roald Amundsen.

PROFESSOR P. DEBYE, professor of physics at the Technical Institute at Zurich and formerly professor at the University of Göttingen, will stay at the research laboratory of theoretical physics of the Massachusetts Institute of Technology, from January 5 to March 15, 1925. During this period he will give a series of lectures on "Some modern aspects of physical chemistry" and direct some research.

DR. V. H. BLACKMAN, professor of plant physiology and pathology at the Imperial College of Science and Technology of London and president of the botanical section of the British Association for the Advancement of Science, has been visiting and lecturing at several American botanical institutions. His first address was at the dedication of the Boyce-Thompson Institute for Plant Research at Yonkers, September 24, after which he lectured at the following universities and institutions: Columbia, Brooklyn Botanic Garden, Cornell, Michigan, Chicago, Wisconsin, Minnesota, Iowa State College, Missouri Botanical Garden, Bureau of Plant Industry of the U. S. Department of Agriculture and the Massachusetts Agricultural College. He was also guest of the botanical departments of Yale and Harvard and of some other institutions.

DR. WILLEM EINTHOVEN, professor of physiology at the University of Leyden, Holland, who was recently awarded the Nobel prize for medicine, gave a lecture to the combined Rush Society and Physiological Society of Philadelphia, on December 1, on the subject "The use of fine threads in physiology." On December 4, he gave the Newbold lecture at the College of Physicians on the "Relationship of the mechanical and electrical phenomena of muscular contractions with special reference to the cardiac muscle."

PROFESSOR E. FRANKLIN ARMSTRONG, president of the Society of Industrial Chemistry, London, addressed the scientific staff of the Rockefeller Institute for Medical Research on November 21, on: "The fats from many aspects."

DR. C. V. RAMAN, professor of physics of the University of Calcutta, now acting as research associate at the California Institute of Technology, addressed the members of the Southern California Section of the American Chemical Society at Los Angeles on November 7, his subject being "New light on atoms and molecules."

DR. I. M. KOLHOFF, conservator of the Pharmaceutical Laboratory, of the University of Utrecht, Holland, spoke before the Illinois section of the

American Chemical Society on October 13, on "Potentiometric titration."

Professor William Morris Davis delivered a series of four lectures from November 12 to 18 before the students of geography and geology at Southern Methodist University, Texas, entitled, "Scientific methods of study," "Modern geography," "The Lesser Antilles" and "The Grand Canyon of Arizona."

Dr. S. C. Lind, the chief chemist of the Bureau of Mines, delivered an address on "Helium and its uses" before the Brooklyn Institute of Arts and Sciences on November 8.

The FitzPatrick lectures of the Royal College of Physicians, London, on "The history of anatomy" were given by Dr. Charles Singer on November 11 and 13.

The Schorstein memorial lecture was delivered by Sir Arthur Keith in the anatomical theater of the London Hospital Medical College on December 17 on the subject of the clinical importance of the bulbus cordis.

The Huxley memorial lecture of the Royal Anthropological Institute was delivered on November 25 in the rooms of the Royal Society, London, by Professor Réné Verneau on the subject "La race de Neanderthal et la race de Grimaldi: leur rôle dans l'humanité."

On October 18, Sir Archibald Garrod delivered the Harveian oration before the Royal College of Physicians. His subject was "The debt of science to medicine."

The three hundredth anniversary of the birth of Thomas Sydenham was commemorated at a meeting of the president and fellows of the Royal College of Physicians of London on November 12. There was a reception in the evening, followed by an address by the president, Sir Humphry Rolleston.

Dr. George Chandler Whipple, professor of sanitary engineering at Harvard University, died on November 27, aged fifty-eight years.

Dr. Edmond Sauchon, formerly professor of anatomy and of clinical surgery at Tulane University, recently died at the age of eighty-three years.

Dr. Walter Elmore Fernald, for more than thirty-five years superintendent of the Massachusetts School for Feeble-minded, died on November 28, aged sixty-five years.

Sir Maurice Fitzmaurice, F.R.S., distinguished English engineer, died on October 18, aged sixty-three years.

R. W. M. Thomson, assistant lecturer in chemistry at King's College, University of London, died on November 5, aged twenty-five years.

Dr. B. Glanvill Corney, English physician and anthropologist, known for his work with the Fijians, died on September 29, at the age of seventy-three years.

The American Ornithologists' Union at its forty-second annual meeting held recently in Pittsburgh reelected the present staff of officers to serve for the coming year. The list follows: *President,* Jonathan Dwight, New York City; *vice-presidents,* Joseph Grinnell, Berkeley, Calif.; Alexander Wetmore, Washington, D. C.; *secretary,* T. S. Palmer, Washington, D. C.; *treasurer,* W. L. McAtee, Washington, D. C.

The nine hundred and ninth meeting of the Philosophical Society of Washington was held in the Cosmos Club auditorium on November 29, when Dr. W. W. Coblentz gave an illustrated lecture on "The measurement of planetary temperatures" and W. D. Collins talked on the "Temperature of air and water."

The Association of Scientific Apparatus Makers of the United States met on November 14 and 15, at the plant of the Taylor Instrument Companies, Rochester, N. Y. After a luncheon, a trip through the plant and an informal "get together," papers were read, followed by discussions.

On November 15 the Royal Canadian Institute celebrated its seventy-fifth anniversary. Addresses were delivered by Sir Robert Falconer, president of the University of Toronto, on "The humanism of science," and by Dr. A. P. Coleman, professor of geology in the University of Toronto, on "The Royal Canadian Institute's contribution to science."

In connection with the forthcoming meeting of the American Association for the Advancement of Science in Washington, extensive plans have been made for the sessions of Section E, Geology and Geography, through Dr. Mendenhall, chief geologist of the Geological Survey, and vice-president and local representative of the section, rooms for the sessions have been secured in the survey building. This will add much to the interest of the meeting particularly for the geologists attending. In order that some geologists may attend the meetings of both the association and the Geological Society of America, at Ithaca, it has been decided to begin the sessions of the section at 10.00 A. M. on Tuesday, December 30, and continue them to January 2. On the evening of December 30, an informal dinner will be held by the members of Section C and the Association of American Geographers, at the Blue Triangle Center and Recreation Club of the Y. W. C. A. at 7.00 P. M., the price per plate being $2.00. During the evening the addresses of the retiring president of the Associa-

tion of American Geographers and of the retiring vice-president of Section E, will be given, and the remainder of the evening will be spent in a social gathering so that the members may become better acquainted. It is intended to devote one session to a symposium on "Ancient climates" and several afternoons to excursions to the Geophysical Laboratory, the museums, and, if weather conditions are favorable, the field in the vicinity of Washington. One session will be devoted to the problems which the geological and geographical division of the National Research Council is working on.

The Journal of the American Medical Association states that the Fonds d'Etudes Roche has been organized by the manufacturing chemists, F. Hoffmann-La Roche and Co., who offer space in their establishment, at Basel, to research workers in experimental medicine and biology, and all facilities for research and a stipend, if desired. Only exceptionally will a longer course than three months be granted. The places are open to medical students, physicians and other scientists. Professor F. de Quervain, Kirchenfeldstrasse 60, Berne, is chairman of the committee, to whom application must be made and credentials presented. The work is entirely independent of regular work in the establishment, and the subject must be approved by the committee, consisting of Professors Cloetta, Zurich; Michaud, Lausanne; Roch, Geneva; Staehelin, Basel, and de Quervain, Berne.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $250,000 has been made to the Hampton and Tuskegee Endowment Fund by an anonymous New York banker.

A CONTRIBUTION of £1,000 has been received from Lord Glendyne towards the Jubilee Endowment Fund of the London School of Medicine for Women, which is intended to provide for the endowment of three chairs in the school—anatomy, physiology and pathology. The sum of £27,500 has now been raised towards the completion of the proposed £60,000 endowment.

DR. W. J. MILLER, for some years professor of geology in Smith College, has accepted a position as professor of geology and chairman of the department in the University of California, Southern Branch, Los Angeles.

WARREN E. LORING, of the University of Maine, has been appointed assistant professor of mathematics at Colby College, to fill the vacancy caused by the illness of Professor Benjamin Edward Carter.

DR. GEO. F. WEIDA, of Kenyon College, has been appointed professor of chemistry at Centre College, Kentucky.

AT the Polytechnic Institute, of Brooklyn, N. Y., Dr. Parke B. Fraim, of Lehigh University, has been appointed assistant professor of physics, and Frank D. Carvin, of the University of Pennsylvania, assistant professor of mechanical engineering.

AT Tulane University, Dr. Parry Borgstrom has been appointed assistant professor of industrial chemistry, and A. Lee Dunlap, assistant professor in mechanical engineering, in the place of Ivor O. Mall, who has resigned.

DR. WALTER C. CRAIG, assistant director at the Johns Hopkins Hospital, Baltimore, has resigned to accept a position in the department of surgery at Yale University School of Medicine. Dr. Craig will be succeeded by Dr. John H. Snoke, who until recently was superintendent of St. Luke's Hospital, Shanghai, China.

MRS. LUGAN KEENE has been appointed professor of anatomy at the London School of Medicine for Women.

SIR CUTHBERT WALLACE has been elected dean of the faculty of medicine at the University of London.

PROFESSOR H. H. DIXON, whose appointment to the Regius chair of botany in the University of Glasgow was recently announced, is unable to accept the appointment.

DISCUSSION AND CORRESPONDENCE

A NEW FORMULA FOR THE ELECTRICAL RESISTANCE OF CERTAIN INHOMOGENEOUS SYSTEMS

IN a recent issue of SCIENCE (1924, lix, 403) Dr. F. H. MacDougall proposes a formula for the resistance of living cells suspended in a medium.

$$R = M\left[\frac{1 + a\left(\frac{S - M}{2S + M}\right)}{1 - 2a\left(\frac{S - M}{2S + M}\right)}\right]$$

In which S is the resistance of the cells, M the resistance of the medium and R the resistance of the suspension of cells in the medium and a the cell volume. This formula is the same as formula 17, page 440, in Clerk Maxwell's "Electricity and Magnetism," third edition, Vol. 1, 1892, provided the algebra is translated into the same form. Maxwell's formula is:

$$R = M\left[\frac{(2S + M) + a\,(S - M)}{(2S + M) - 2a\,(S - M)}\right]$$

By dividing both numerator and denominator of the fraction inside the brackets by $(2S + M)$ we obtain MacDougall's formula.

In a paper by F. H. MacDougall and R. G. Green in the *Journal of Infectious Diseases* (1924, xxxiv, 195), the formula for the resistance is:

$$\frac{1}{R} = \frac{1-a}{M} + \frac{a}{S}$$

after translating one term into the conventions of MacDougall's paper. In a paper by Karl Lichtenecker on the resistance of certain composite conductors in the *Physikalische Zeitschrift*, 1918, xvii, 381, is given a formula which when translated into MacDougall's terms is:

$$R = \frac{SM}{(1-a)\ S + aM}$$

If we reduce MacDougall's equation to a common denominator we obtain

$$\frac{1}{R} = \frac{(1-a)\ S + aM}{SM}$$

and by taking the reciprocals of each side of this equation we obtain the equation used by Lichtenecker.

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HOW MANY FIGURES ARE SIGNIFICANT?

THE readers of SCIENCE are aware that varying practices are followed by the workers in the natural and social sciences regarding the number of decimal places kept and reported in their investigations. A definite and uniform practice would conduce to general understanding. Discussions with my colleagues regarding certain quantitative studies of my own which promised to be serious and worth-while have become mired around the decimal point. As a result of this I have determined upon a rule for my personal guidance which I believe may be of general utility.

Determine the probable error of the measure involved, by statistical means if possible, otherwise estimate it. *Keep to the place indicated by the first figure of ½ the probable error.*

As an illustration, suppose we calculate the mean and standard deviation of a certain series and find:

Mean = 81.7433
Standard deviation = 12.8294
Population = 100
The probable error of the mean according to the usual formula = .865
The probable error of the standard deviation according to the usual formula = .612
½ the probable error of the mean = .432
½ the probable error of the standard deviation = .306

Following the rule, we would publish: Mean = 81.7 and the standard deviation = 12.8.

As a second illustration: Suppose we have a correlation coefficient of .75248 from a population of 400. Its probable error, according to the usual formula, is .0146. One half the probable error equals .0073. Accordingly, the correlation coefficient should be published as equal of .752.

The argument underlying this rule is that one should not throw away data that are likely to influence judgment. A difference of 1 probable error indicates that the chances are 3 to 1 that the difference is of the sign indicated. This is scant evidence of significance but not entirely meaningless. A difference of one half of the probable error indicates that the chances are about 5 to 3 that the difference is of the sign indicated. For ordinary purposes this is of insignificant moment. Failure to keep more figures introduces a slight error, but keeping them introduces a much greater error in interpretation by suggesting an accuracy which does not exist. It is necessary to strike a balance and the rule suggested is offered as a reasonable compromise.

It is intended that it be applied to raw or original measures or observations as well as to derived constants such as averages, measures of variability, etc. It is to be expected that computation work preceding publication will be carried to at least one figure further than the final published result.

TRUMAN L. KELLEY
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OPPORTUNITIES FOR SCIENCE TEACHERS IN NEW YORK HIGH SCHOOLS

A LETTER requesting information regarding opportunities for science teachers in the high schools of New York City was received by the writer some months ago from an associate professor in a large collegiate institution east of the Mississippi. The information furnished may be of interest to others and is outlined below. There is a real opportunity for important work, both in science education and in supplementary graduate work in science.

(1) There has been for some years a shortage of well-qualified teachers, especially of men for the boys' high schools. Three successive examinations in biology netted not more than three or four successful candidates, who were immediately appointed.

(2) The population of the New York City high schools stands at present at one hundred and ten thousand, and increases by thousands every year. All these ought to have several courses in science, and it appears that recognition of this fact is growing on the part of the administrative officials, and science work is entering a floodtide. At present between four and five hundred specially selected science teachers are required to offer the courses now given.

(3) The salary of the regular high school teacher,

called "assistant teacher," ranges from nineteen hundred to thirty-seven hundred dollars. Credit is given in the initial salary for recognized outside teaching experience and graduate work. By a further examination for the license of "first assistant," a progression to forty-two hundred dollars is possible, with administrative duties as chairman of department. Such departments range in size from two or three to forty teachers. High schools range from one to eight thousand pupils. At the last count there were thirty-five secondary schools ranked as high schools, with more new ones in prospect.

(4) Opportunities for continued graduate work and research are probably not equalled or even approached elsewhere in the country. The educational problems constitute an intensely interesting and important field of work in themselves, and New York is headquarters for more kinds of pure and applied scientific research than anywhere else. The universities, professional schools, libraries, science foundations, botanic gardens, museums, industrial establishments, et al., all offer problems by the score, with facilities for the qualified investigator. For those who have not finished graduate study toward a degree, the universities offer important graduate courses on Saturdays.

(5) Full details regarding the stated examinations, etc., may be obtained by addressing the Board of Examiners, 500 Park Ave., New York City. Following are paragraphs taken from their circular of information, and giving some of the facts a prospective candidate for the examination would be interested to know.

(a) Teaching positions in New York City are secured by competitive examination, a part of which is written. These examinations usually held twice a year, in November or December, and in March or April, usually at a time when the New York City public schools are not in session.

College graduation and one year's teaching experience, or, in lieu of teaching experience, one year of post-graduate work which must include 60 hours in the methods of teaching the subject.

(b) It takes nearly a year for examiners to make proper evaluation of the candidates' references, scholarship and records of service so that persons applying for New York City positions who take the examination should not look for appointment any earlier than one year from the date of the written examination.

Copies of the last written examination question paper may be obtained, while they last, from the Board of Examiners, 500 Park Avenue, New York, upon request, enclosing a stamped and self-addressed envelope.

RALPH C. BENEDICT

STUYVESANT HIGH SCHOOL AND
BROOKLYN BOTANIC GARDEN

SUGGESTED MODIFICATIONS OF THE CELLOIDIN METHOD

UNDER the caption "A shorter celloidin method" there recently appeared in SCIENCE (No. 1542, July 18, 1924, p. 67) a description, signed by J. E. Lodewick, of a tank made of an iron pipe, for use in imbedding tissues with celloidin under pressure. The present writer wishes to suggest some modifications which have been found advantageous.

Instead of using a piece of iron pipe for the tank a heavy glass jar can be used, provided the pressure is not run too high. In an apparatus of this kind, described in detail by the writer in the April, 1914, issue of the Proceedings of the Society of American Foresters, a pressure of 30 pounds per square inch can safely be used.

The great advantage of the glass jar is, of course, that the material can be observed without opening the chamber. Hence, certain obvious precautions can be taken against too rapid release of pressure and attendant bubbling over of the celloidin or the celloidin becoming too low on account of an insufficient original supply.

The writer has also found that woody material can be satisfactorily imbedded by the pressure method by using only a 10 per cent. solution of celloidin, provided a liberal supply is used to begin with. Thus, one avoids the necessity of any transfer of material to a higher concentration. Another way of hastening the process with tissues that can endure higher temperatures is to heat and cool the chamber alternately at intervals of several hours. The increased pressure should be applied particularly while the celloidin is cooling, so as to secure penetration into the cell cavities while the gases are contracting and condensing within.

ARTHUR KOEHLER

FOREST PRODUCTS LABORATORY,
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A CURIOUS SURGICAL CASE

I HAVE received from Mr. Nisuke Takahasi, a teacher in a high school in Kumamoto, Japan, a specimen of a fish somewhat noted in Japanese surgery.

It is a fish two and four fifth inches (7.0 cm) long taken from a man's throat, in which it had become lodged. The specimen concerned is a common fresh water fish of the clear streams of Southern Japan, locally known as Oyarami or Kawamebaru, very closely related in fact as well as in appearance to some of our American freshwater sun-fishes (*Centrarchidae*). Its scientific name is *Bryttosus kawamebari* (Schlegel).

The specimen is virtually perfect, although apparently somewhat emaciated. How it was swallowed is not explained, but it is evident that its sharp dorsal spines would hold it in place once swallowed. The specimen was presented to Stanford University by Dr. Toyoji Nishiyama, of the Municipal Hospital at Kuverme, at the suggestion of Dr. Chiyomatsu Ishikawa, of the Imperial University of Tokyo.

David Starr Jordan

Stanford University

SCIENTIFIC BOOKS

Human Origins, a Manual of Prehistory. By George Grant MacCurdy, *Ph.D.* Vol. I, *The Old Stone Age and the Dawn of Man and his Arts,* 440 pages; Vol. II, *The New Stone Age and the Ages of Bronze and Iron,* 516 pages. D. Appleton and Company, New York.

A reader whose interest in the prehistoric archeology and ethnology of Europe is professional will scrutinize the qualifications of the author of any work on this subject before turning over the pages of the work itself. Such a reader will desire to know whether or not the author has a first-hand knowledge of his subject. What experience has he had in the excavation of archeological sites? Does he know the collections of prehistoric material in European museums? Is he competent to pronounce upon geological and paleontological questions? Is he a physical anthropologist? Unless he is satisfied with the qualifications of the author, the worker in the field of knowledge dealt with will decline to give serious consideration to his writings.

In the present instance the reader may proceed to the perusal of "Human Origins" with complete confidence that it is the output of a competent scientist writing within the field of his own special knowledge and experience. Dr. MacCurdy has been trained in the methods of European prehistoric archeology and in the technique of physical anthropology by the foremost Continental authorities in these subjects. For many years he himself has conducted excavations in prehistoric European sites; his writings have furnished American anthropologists with the latest information on progress of the science in Europe; he is one of the two or three Americans who are recognized abroad as authorities on European prehistoric archeology. Further, he brings to bear upon European questions his extensive experience in the archeology and physical anthropology of the New World.

To a teacher of European prehistory the outstanding merit of Dr. MacCurdy's work is its comprehensiveness. It deals with the entire prehistoric period. It does not leave the reader stranded on a terminal moraine in the company of fossil men, extinct animals and chipped stone implements. With the exception of Déchelette's great work ("Manuel d'archéologie préhistorique, Celtique et Gallo-Romaine"), now somewhat out-of-date, "Human Origins" is the one satisfactory attempt to carry the prehistory of man in Europe through to the present era in an adequately detailed treatment.

The first volume deals with the Old Stone Age and fossil man. Here Dr. MacCurdy is at his best. Climatic and geographical conditions, prehistoric chronology, types of fossil men and animals, industries and arts of the various archeological periods—all these subjects are thoroughly discussed, but with due regard for their relative importance. A disproportionate amount of space is not allotted to any particular feature. MacCurdy does not build his book upon some one aspect of prehistory, subordinating all other subjects to that of his own specialized knowledge and interest. A few crucial points in this volume should be noted. The author accepts the Foxhall eoliths of the Pliocene period; he assigns the Acheulian industry to the Rissian glaciation and places the beginning of the Mousterian industry in the third interglacial (Riss-Würm) period; he regards the Piltdown mandible as human, but is not certain that it belongs with the associated brain-case fragments. The section on fossil man is concise but complete. In the opinion of the reviewer, Dr. MacCurdy does not sufficiently consider the evidence pointing toward the existence of an essentially modern type of man in the Lower Paleolithic Age.

The second volume is devoted to the Mesolithic, Neolithic, Iron and Bronze Ages and to valuable appendices dealing with the stratigraphy of paleolithic sites and with the distribution of paleolithic art and of prehistoric monuments. Appreciation of the inclusion in this work of a summary of the early metal periods has already been expressed. What the author has to say of the Bronze and Iron Ages is, so far as it goes, excellent. But of the 918 pages of text, plates and bibliography included in the two volumes, only 52 pages are devoted to the Bronze Age, and the Iron Ages are crowded into 71 pages. Yet from the historical, ethnological or archeological viewpoints these are the most important periods of European prehistory. Fossil man is accorded 136 pages of discussion and recent man receives a scant 7 pages. There is no adequate treatment of late prehistoric and proto-historic racial movements. The reviewer does not cavil at the thorough and detailed treatment of the Paleolithic Age to which Dr. MacCurdy has devoted the bulk of his work. He only regrets that the author did not extend his treatise sufficiently to satisfy also the acute academic need

for a full discussion of the later periods. Civilization, after all, is cumulative and the nearer the archeologist approaches to the historical period the more extensive his material becomes and the more numerous and vital are the problems which he must endeavor to solve.

"Human Origins" is the most useful manual of prehistory available to readers of English. It surpasses the work of Déchelette in its superior grasp of problems of physical anthropology. The illustrations of MacCurdy's work are also more numerous and better. The classical French work is, however, better balanced. The scant notice accorded to the archeology of the Eastern Mediterranean area is less excusable in a general manual of prehistory than in a work primarily concerned with the archeology of France. But, without a doubt, students of prehistory are to be congratulated upon the publication of this scholarly treatise which is the work of no amateur but of a dependable authority.

E. A. HOOTON

HARVARD UNIVERSITY

SPECIAL ARTICLES

ELECTRIC TRANSPORT OF FLUID ACROSS MAMMALIAN SEROUS MEMBRANES

EXPERIMENTS performed during the past year have shown that the serosae of mammals are amphoteric membranes. If the membrane is bathed in dilute blood or buffer more alkaline than a certain critical hydrogen-ion concentration and traversed by an electric current, the liquid streams through the membrane toward the cathode. With buffers more acid than the reversal point, streaming is toward the anode. A reversal in sign of the electrokinetic potential difference[1] between the membrane pore walls and the liquid in the pores is thus indicated.

The mesenteries of anesthetized living dogs, cats and rabbits, the mesenteries and parietal pericardia and pleurae of the same species, post-mortem, and two human pericardia, post-mortem, have thus far been tested. These membranes are essentially sheets of connective tissue, bearing blood vessels, lymphatics and nerves, and in some instances, fat cells, lined on each surface by a single layer of pavement mesothelial cells. Intercellular fibers form the major bulk of the lean membranes; these are predominantly collagenous except in the pleural sheet between pericardium and diaphragm where elastin fibers may be present in large proportion.

The reversal point of a complex, amphoteric membrane may be defined as that concentration of H-ions in a given solution within the pores of the membrane, traversed by an electric current, at which the total electroendosmotic current through the membrane is zero.

The mean values of the reversal points with citrate-phosphate buffers for all tissues studied have been between $pH = 4.3$ and $pH = 5.3$. By using buffers alternately more acid or alkaline than the reversal point the direction of liquid flow across any given membrane site may be reversed an indefinite number of times. The time interval required is only that taken for the requisite manipulation in changing buffers and making the runs.

The buffers used have been dilutions of McIlvaine's[2] citric acid-sodium phosphate mixture and certain isotonic, physiologically balanced buffers. The latter were citrate-phosphate mixtures containing Na, K and Ca in the proportion of Ringer's solution, and made isotonic by the addition of glucose or of glycerin. The glycerin buffer was found preferable.

The mean values of the reversal points for the several membranes when bathed in the hyptonic unbalanced buffer and in the isotonic, physiologically balanced buffers showed only small and inconstant differences.

The fat and lean membranes in each category similarly showed small if any difference in the positions of the mean reversal points.

The apparent reversal points for the mesenteries of living animals proved to be lower than those for the mesenteries post-mortem. This low value in the animals with functioning circulation has been ininterpreted as essentially due to admixture with the buffers of buffer salts from the blood. Distinct differences have not been detected between the reversal points of the membranes in the first compared with later hours or days post-mortem, with the possible exception of a small shift toward the acid range of the fat pericardia reversal points when tested several days post-mortem.

The approximate mean reversal points found with the citrate-phosphate buffers were as follows: for mesenteries of living animals, $pH = 4.4$; for pleurae, post-mortem, $pH = 4.6$; for mesenteries, post-mortem, $pH = 4.8$; for lean and fat pericardia, post-mortem, $pH = 5.1$. The mean reversal point estimated for the human pericardia was about $pH = 5.0$. The concentration of hydrogen-ions requisite for reversal of the membranes with these buffers containing polyvalent anions is greater than with an acetate buffer.

The ready reversibility of the membranes would seem to indicate that their charging, *i.e.*, electrokinetic p. d., is ultimately dependent largely upon the dis-

[1] Freundlich, H., and Gyemant, A., *Ztschr. f. physik. Chem.*, 1922, c, 182.

[2] McIlvaine, T. C., *J. Biol. Chem.*, 1921, xlix, 183.

sociation state of certain amphoteric components of the membranes. The position and sharpness of the reversal points is strongly suggestive of these ampholytes being proteins. The conclusion seems warranted that proteins probably constitute an important part at least of the material of which the membrane cell surfaces are composed.

STUART MUDD

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SELACHIAN "DENTICLES" IN THE CAT[1]

It is now well known that the human lips at birth possess an inner zone beset with "long, soft, villus-like outgrowths." In a few weeks, these villi largely disappear, though the zone itself remains more or less distinctly marked throughout life. Denuded of their epithelium, Ruysch figured them as "papillae," in 1707. Luschka (1863) was the first to describe them with modern precision, and since then they have been the subject of important studies by Neustätter, Stieda, Ramm and others. The portion of the lip which bears the villi is clearly distinguishable to the naked eye, and the individual projections, with their vascular cores, may be seen on low magnification. Neustätter, in 1895, remarked that so far as his investigations showed, human lips alone are provided with this double zone—the outer of which is smooth, and the inner, villous—and he rather fantastically ascribed the condition to the shortness of the nipples and flatness of the central area of the breasts in women. Thus human infants require a special "Greifapparat" for an airtight contact!

Rejecting this interpretation—of "non-skid" lips, as his assistant called them—and after reviewing the literature in the way here outlined, Dr. F. T. Lewis proposed a different interpretation (Buffalo meeting of the American Association of Anatomists, April 16, 1924). He showed photographs of the labial "villi" in man, and others of the teeth of the skate, both intact and in sections, and proposed to regard them as homologous structures. That is to say, he considered the human labial villi, notwithstanding their small size, their tendency to point outward and their lack of dentine, as actual denticles or potential selachian teeth. In the human oral region, then, in addition to the gill clefts, there would be another striking suggestion of the ichthyoid plan of development.

The present account is intended to report the finding of bilaterally arranged papilliform structures on the inner surface of the upper lip in the newborn kitten. These are very clearly the equivalents of the villi or denticles of the human lip, though the inner zone which they form is not exposed at the oral margin; they are wholly within the lips.

On the upper lip of the kitten they are arranged in three groups in the specimens studied—a median group, and on either side, a lateral group.

The median group consists of a single row of four large incisor-like papillae, which might possibly be mistaken for teeth, but the well-defined dental ridge is further within the mouth, and these papillae have no connection with it. Of these four papillae those next the midline are the largest and measure 1.0 mm in height by 0.75 mm in width at the base. They are flattened in the same plane as the human incisors. Their free margins are somewhat rounded and are without serrations. The lateral members of this group are very similar though a little smaller.

On either side of the median group is a lateral group of from twenty to thirty smaller papillae, bluntly conical in shape and arranged in poorly defined rows. Those in one row may partially overlap the units in the next row. These papillae do not stand erect, but their tips are turned somewhat forward and toward the median line. Beyond the lateral groups, in the direction of the corners of the mouth, a portion of the lip is quite smooth.

The papillae in all the groups consist of connective tissue cores covered with a very thick epithelium, much thicker than the epidermis. In these respects they are like the papillae of the human lips, but they are neither so slender nor so vascular. No dentine has been observed.

The location of the villi would seem to preclude the possibility of their serving to strengthen the animal's grasp upon the nipple. Without assigning to these rather remarkable structures any function, I would regard them, provisionally at least, as "denticles," for superficially their resemblance to selachian teeth is very striking.

During the month that this report has been in press, 130 kittens and cats have been examined, and although the villi early disappear in man, in the cat they are found to be retained throughout life. Their number diminishes, and those of the median group become merely moundlike masses limited by furrows. In the lateral groups, however, the loss in number is accompanied by an increase in size, and the acquisition of a more definitely pointed character, in those which remain. They may attain a length of 2.75 mm. and a breadth of 1.25 mm. In general they point downward and outward, but instances are not rare in

[1] A study conducted as Medical Fellow of the National Research Council.

which they project upward or even directly backward into the oral cavity. The further study of these remarkable "denticles" is in progress.

BARRY J. ANSON

HARVARD MEDICAL SCHOOL,
SEPTEMBER, 20, 1924

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF BIOLOGICAL CHEMISTRY

R. A. Dutcher, *secretary*
W. T. Bovie, *chairman*

A Study of the Nutritive Value of Gelatin: THOMAS B. DOWNEY. The results of an investigation of the supplementary value of gelatin as a protein where fed with a number of foods common to the dietary, and of the influence of the colloidal properties of gelatin upon the digestion and absorption of various dairy products. Feeding tests with the albino rat have shown that gelatin, as a protein, supplements the protein deficiency of wheat, wheat products, oats, rye, barley and barley products. Gelatin does not, however, increase the food value of navy beans or corn. Further observations have demonstrated that gelatin by virtue of its colloidal properties increases the nutritive value of dairy products, such as cow's whole milk, egg and milk, and ice cream (typical commercial formulas).

The Antirachitic Action of Fresh Cod Liver Oil as Compared with that of a Concentrate Prepared from the Oil: HARRY E. DUBIN. Young rats were placed on a rickets-producing diet for a period of 30 days. During this time, one group of rats received daily doses of varying quantities of fresh cod liver oil. Another group was given an equivalent amount of cod liver oil in the form of a concentrate prepared from the oil. A third group acted as controls. At the end of the experimental period, the animals were X-rayed. The controls showed rickets, while those receiving either cod liver or the concentrate remained free from rickets.

The Physiological Activity of Some Synthetic Compounds Closely Related to Thyroxin: E. C. KENDALL and A. E. OSTERBERG. Alpha oxy-indol propionic acid in glacial acetic acid will substitute bromine on its imino group and HBr will then split out between the N and No. 7 carbon. This bond also occurs in all the halogen substituted derivatives of alpha oxy-indol propionic acid. Experiments have demonstrated the great physiological activity of this bond which under the conditions in the animal organism acts as an active hydrogen acceptor. The relation of this finding to thyroxin and oxidation in the animal organism will be discussed.

A New Type of Organic Phosphoric Acid Compound Isolated from Blood: ISIDOR GREENWALD. A compound which appears to consist of two molecules of phosphoric acid united with one molecule of 1-glyceric acid has been isolated from pig blood, in which it forms at least one third of the total "acid-soluble" phosphorus. It is very resistant to acid hydrolysis. A compound of the same nature is present in the blood of man and the dog but not in that of the cow and the sheep.

Quantitative Determination of Vitamin A: H. C. SHERMAN and H. E. MUNSELL. In order to determine the relative amounts of vitamin A in foods, a method has been developed upon the plan proposed by Drummond, Coward, Zilva and their coworkers. Standardized animals are fed a vitamin-A-free, otherwise adequate diet until growth ceases; and then the amount of food which when fed daily will just suffice to permit a gain in weight of approximately 3 grams per week for 8 weeks is ascertained. Standardization of animals, diets, procedure and interpretation is discussed.

Further Experiments upon Vitamin A: H. C. SHERMAN and L. B. STORMS. This investigation deals with (1) the age at which experimental animals (albino rats) attain their maximum body store of vitamin A, (2) the influence of previous feeding upon the relative store of vitamin A in the body at a given age, (3) the influence of variations in body weight at a standard initial age, (4) the influence of family, and (5) the question whether the sexes differ in their capacity to store vitamin A or to endure deprivation of this vitamin.

A Ration Low in Calcium as a Factor in the Production of "Stiffness" in Swine: L. A. MAYNARD, S. A. GOLDBERG and R. C. MILLER. The trouble in pigs variously referred to in popular language as stiffness, paralysis and rickets was produced on a ration low in calcium, consisting of yellow corn, wheat middlings and oil meal, but did not result where the same feeds were supplemented with bone meal and limestone, nor was it produced on a ration of yellow corn, middlings and fish meal. The femurs of the pigs receiving the low calcium ration contained less than two thirds as much calcium and phosphorus as the femurs of littermates on the other two rations. Corresponding differences were found in the structure of the bones on section. On microscopic examination the bones from the pigs on the ration low in calcium showed marked and constant lesions. The data indicate that the stiffness was a result of inadequate mineral nutrition of the bones due to a ration deficient in calcium.

Vitamin B in Evaporated Milks Made by Vacuum and Aeration Methods: R. ADAMS DUTCHER, EMMA FRANCIS and W. B. COMBS. Sterilized and unsterilized evaporated milks, made by vacuum and aeration methods, were fed to rats receiving a ration deficient in Vitamin B. Control groups were fed equivalent amounts of raw herd milk from which the evaporated milks were made. The results indicate that evaporation (by vacuum and aeration methods) did not injure Vitamin B appreciably, although slight destruction took place. After sterilization of the evaporated milks, the destructive effect was more marked, particularly in the evaporated milks made by the aeration method. The destructive effect can hardly be considered of serious nutritive significance.

Work is now in progress relative to the effect of evaporation and sterilization on Vitamins A and C.

The Significance of the Occurrence of Copper, Manganese and Zinc in Shell-Fish: J. S. McHargue. Small amounts of the elements copper, manganese and zinc are widely distributed in nature. The author found, in parts per million of the moisture-free matter, copper, iron, manganese and zinc in the following species of shellfish: Crayfish, 75 cu; 896 Fe; 250 Mn; 320 Zn. Mussel, 12 cu; 1,325 Fe; 5,424 Mn; 750 Zn. Clam, 16 cu; 711 Fe; 43 Mn; 1,359 Zn. Oyster, 231 cu; 208 Fe; 49 Mn; 4,284 Zn. Lobster (edible meat) 85 cu; 54 Fe; 12 Mn; 160 Zn. Crabs (entire bodies), 68 cu; 134 Fe; 16 Mn; 1,216 Zn. The author assumes that copper, manganese and zinc are vitally concerned in the metabolism of shell-fish and are probably vital factors in the metabolism of higher animals as well.

The Relation of Phenols to Xerophthalmia, Calcium-Phosphorus Retention and Growth: R. C. Huston and H. D. Lightbody. White rats received a diet high in calcium and low in phosphorus of the following percentage composition: Purified casein (20), dextrin (59.6); hydrogenated cotton seed oil (14), salt mixture (McCollum's XXI) (3.9), calcium carbonate (1.5) and butter fat (1.0). Water soluble B vitamin was supplied by feeding "Yeast Vitamin (Harris)." Another group received the same diet containing 0.05 per cent. hydroquinol. Growth curves, tables of calcium-phosphorus balance, post-mortem examination and date of development of xerophthalmia lead to the conclusion that hydroquinol exerts a protective influence against the development of xerophthalmia and improves the general well-being of the rats, permitting growth and aiding calcium and phosphorus retention.

Studies of the Vitamin Potency of Cod Liver Oils. XIV—The Variation in Daily Food Consumption of Experimental Animals: Arthur D. Holmes. The daily food consumption of over two hundred albino rats have been averaged to determine the average daily food consumption during the experimental period of sixty days. The information obtained in this manner shows that the average food consumption varied from day to day. It was also found that on each of the sixty days the food consumption of a large portion of the experimental animals was not within 10 per cent. of the average food consumption of the group. From this it is evident that if one wishes to feed uniform daily amounts of cod liver oil to experimental animals, this can be more satisfactorily accomplished by feeding the oil apart from the diet rather than as a component of the experimental diet.

Studies of the Vitamin Potency of Cod Liver Oils, XV—Characteristics of Crude Cod Liver Oil, Medicinal Cod Liver Oil and Cod Liver Stearin: Arthur D. Holmes and Margaret M. Patch. Under modern methods of manufacture, the crude cod liver oil obtained by promptly rendering strictly fresh cod livers is satisfactory for edible purposes in so far as color, odor and taste are concerned. Crude cod liver oil, however, contains cod liver stearin, which solidifies at winter temperatures, causing the oil to become cloudy and at extreme temperatures semi-solid. To produce a non-freezing cod liver oil, the crude cod liver oil is chilled and separated into medicinal cod liver oil and cod liver stearin. Analyses of a number of lots of medicinal cod liver oil, cod liver stearin and the crude oil from which they were obtained show that the chemical and physical characteristics of the crude cod liver oil and the medicinal cod liver oil obtained from it are very similar.

Studies on Cholesterol. I. Synthesis of Cholesterol in the Animal Body: F. S. Randles and Arthur Knudson. In order to determine whether or not cholesterol is synthesized by the animal body, a number of white rats were placed at the time of weaning on a cholesterol free diet. Another series of rats were placed on exactly the same diet to which known amounts of cholesterol had been added, and still another series were kept on the ration diet used for stock animals. The offspring from each series were continued on the diet of the parent rats. At about 5 months of age the rats were killed and the blood, brains and livers were extracted and the cholesterol content of these tissues determined. This has now been carried through the second generation in each case. In every case the cholesterol content of the tissues of the rats receiving no cholesterol in their diet has been as high as that of the other rats, indicating a synthesis of cholesterol by the animals on a cholesterol free diet. The growth and appearance of the cholesterol free rats have been normal.

Methemoglobin: J. B. Conant and L. F. Fieser. Methemoglobin may be determined by electrometric titration with sodium hydrosulfite or anthrahydroquinone sulfonate. Results thus obtained, when compared with the total hemoglobin content (colorimetric) and the oxygen capacity, affords additional proof that the change from methemoglobin to hemoglobin involves one hydrogen equivalent of reducing agent. A new method of determining methemoglobin in the presence of cleavage products has been developed which depends on the fact that methemoglobin may be quantitatively reduced to hemoglobin, whose oxygen capacity can then be measured. A study has been made of some of the factors influencing the decomposition of hemoglobin solutions and the formation of methemoglobin by a variety of oxidizing agents.

The Antirachitic Activation of Crude Fats and Other Substances by Exposure to Light: H. Steenbock, A. Black and M. T. Nelson. Following up the work of Goldblatt and Soames, it has been found that tissues, rations and crude fats, which possess little or no antirachitic properties, may become activated and possess marked antirachitic properties after exposure to light. In the case of fats the antirachitic properties are localized in the unsaponifiable constituents of the fat.

R. A. Dutcher,
Secretary.

SCIENCE

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THE PRESENT STATUS OF THE BIOGENETIC LAW[1]

THE biogenetic law or the doctrine of recapitulation not long ago ranked as one of the most important principles of biology. In recent years it has been attacked repeatedly both from the botanical and zoological sides. Since the basal data upon which it is founded have not at any time been called in question and in fact have rather increased in number and importance, as a result of the more recent historical and developmental study both of plants and animals, it becomes a question of interest to discover why this change of attitude has taken place. One of the most important reasons for the momentary eclipse of the doctrine of recapitulation is doubtless the present vogue of the doctrine of mutation. It is distressing apparently to the mutational state of mind to grant that the past history of living beings is an important factor in their present organization. If it be generally true that new species can originate all at once by saltation or sudden change, the past history of such species becomes a matter of less importance and it naturally follows that the possibility of such a past being recorded in their developmental stages becomes highly problematical. As a consequence of this situation we have heard much destructive criticism of the biogenetic law on the part of zoologists of mutational tendencies, such as Montgomery, Morgan and others. It has been asserted, for example, that the gill arches of the mammalian embryo do not indicate, as was previously supposed, an aquatic habit on the part of ancestral forms from which on the basis of paleontological and developmental evidence, the warm-blooded animals have come. It is plausibly suggested that the undoubted presence of gill-arches in the mammalian embryo is an embryonic response to the early aquatic existence in the maternal amniotic fluid. In other words, it is asserted that what the morphologist and the paleontologist explain in terms of the biogenetic law as vestiges of a former state represent merely a larval adaptation, which is of no evolutionary significance. This is substantially the position assumed by Morgan in his "Critique of Evolution," which has recently enjoyed a great vogue.

There is another group of critics of the biogenetic law, whose objections are based too exclusively on a Paleozoic point of view. This group presents an interesting resemblance to those whose training makes

[1] Address delivered by invitation before Section K, British Association for the Advancement of Science, Toronto meeting, August, 1924.

them look at all modern life through the eyes of Greece and Rome. Very often they represent opinions, which, although long received, have by reason of later discoveries ceased to square with the known facts. Obviously it is impossible in a general statement to deal in detail with conscientious objectors of this type.

The higher plants, particularly the Conifers, supply an admirable basis for the examination of the fundamental basis of the biogenetic or recapitulationary law. Since the young of the seedplants is sheltered under uniform conditions throughout, in its embryonic or intraovularial phases, the complications of development known as larval stages in animals do not occur. In this respect, as in so many others, the higher plants show themselves superior to animals for the investigation of general biological principles on the basis of inductive reasoning. In the case of seedplants the process of events is accordingly not obscured or confused by any larval mask so that it is apparently easy, for the open mind at any rate, to interpret the facts of development and history. The situation in the case of plants is further favorable by reason of the many adaptations to actual environment which they have in the course of time been forced as it were to develop, by reason of their sedentary life, which contrasts so strikingly with the generally mobile existence of animals.

A very striking mode of adaptation in the case of plants is found in connection with the growth on a dry soil or one in which the water relations for one reason or another are unfavorable. An excellent illustration of this condition is supplied by the Cactus family. In the genus Peireskia, normal leaves are developed, but many of the other genera are quite leafless except in their early seedling stages, in which they usually develop more or less normal seed-leaves or cotyledons. The genus Cereus is interesting because in some of its species it does not even develop cotyledonary leaves. It is not improbable that related genera, such as Echinocactus, Melocactus, Anhalonium, etc., will prove to be equally without seed-leaves or cotyledons. Preliminary investigations carried on in my laboratory show that in a number of these more highly specialized Cactus genera, even the vessels which so uniformly characterize the angiospermous seed-plants are likewise absent. The occurrence of cotyledons in genera of cacti, which are quite without leaves in the adult vegetative condition, can only be interpreted as the occurrence of an ancestral structure in the seedling, which has quite disappeared in the adult; in other words, as an example of the validity of the doctrine of recapitulation.

There are numerous parallel instances among species inhabiting dry or poisonous soil. For example, we have in North America many species of Veronica, in which the leaves have a quite normal development and a very characteristic form. In certain exotic Veronicas the leaves are very small and are confluent with the surface of the stem. In their young condition these xerophytic Veronicas have, however, leaves precisely like other Veronicas. The same condition is exemplified by the nearly leafless Rubus of the "Malle Scrub" of Australia, which in its seedling condition has leaves like other raspberries. Examples of this kind could be multiplied indefinitely and all show clearly that the young of desert plants show organization resembling that found in allied species growing under normal water supply. Since the young are absolutely under the same conditions of environment as the adults, the differences of nepionic or seedling organization are rationally explained as the persistence of a tendency to grow like the ancestral mesophytic forms, from which the xerophytic or desert-inhabiting modifications were originally derived.

The seedlings of plants which have become adapted to a dry or desert habitat accordingly supply an extremely good illustration of the doctrine of recapitulation, since in their first development they manifest peculiarities which are only explainable as the persistence of a tendency to grow like nearly related forms living under more normal conditions of water supply.

Similar conditions are supplied by plants provided with flattened stems or phylloclads or by that abnormal type of leaf known as the phyllode. In their seedlings these forms usually show the type of organization characteristic of the more normal nearly related species or genera. Innumerable similar examples could easily be supplied of angiosperms showing marked adaptations to special conditions of existence in the adult, which go through a normal development in the young state and thus supply evidence in favor of the validity of the doctrine of recapitulation.

We may now advantageously turn our attention to the conifers, a group of very special interest in the present connection on account of their great geological age. Although the group as a whole is evergreen and has obviously been so for many thousands of years, there are deciduous genera such as the larch (Larix) and the Chinese larch (Pseudolarix) which regularly shed their leaves in the autumn. Interestingly enough the seedling of our larches is for a few years evergreen. Since it grows under precisely the same conditions as the adult, this striking deviation in habit can only be explained as a persistence of an ancestral feature, namely, the typical coniferous evergreen habit, in the young individual and at the same time an exemplification of the validity of the biogenetic law. Another of our commonest and at the same time most interesting conifers is the pine. This is characterized by having its leaves attached to the

stem in clustered fascicles, which in modern species are from two to five in number. In the first year's development the leaves occur singly and directly attached to the stem, which is obviously the harking back to an ancestral condition. In many of our higher conifers the leaves are small and more or less confluent with the surface of the stem. This condition, for example, is found in certain junipers, in the arbor vitae, the big tree, the incense cedar, etc. In the seedling all these forms have quite normal free leaves, the presence of which is explainable on the basis of the doctrine of recapitulation. The Japanese umbrella pine, Sciadopitys, which in the adult bears only needles comparable to those of a two-leaved pine, but fused together, in the seedling condition, for a short time, produces normal leaves. In certain conifers now confined to the southern hemisphere and belonging to the genus Phyllocladus, the branches are flattened to resemble leaves and the real foliar organs are rudimentary. In the seedling normal leaves and stems always are present for a time.

All the above illustrations of the exemplification of the doctrine of recapitulation by the conifers have reference to external organization and to living forms. We shall now turn our attention to the important internal structures and to fossil forms. I have devoted a large amount of time to the study of the anatomical organization of extinct conifers belonging to earlier geological times. It will be of interest in this connection to examine how certain well-known living conifers compare anatomically with their extinct ancestors and what basis they supply for the validity of the doctrine of recapitulation. Mention has already been made above of the pines. This genus, as some of you are aware, is a very ancient one, extending back in substantially its present form at least to the middle of the Mesozoic period (Jurassic). In its earliest occurrence Pinus was different in certain notable respects from its living representatives and, like the Cycads, was much more numerously represented by species than it is at the present time. The earliest pines, instead of the two to five needles in a cluster, which are a feature of our existing pines, had numerous leaves in a fascicle. Another interesting feature of these primeval pines was the fact that the wood in the leaf began its growth towards the upper surface of the leaf as is the case in the earliest known gymnosperms. In anatomical structure the wood was different from our living pines, in several respects, only one of which will be mentioned. In our existing species of Pinus, the rays of the wood are accompanied by horizontal tracheids or water-conducting elements. These structures were absent in the earliest pines. Even at the beginning of the Cenozoic, as exemplified by the pines of the Baltic amber deposits, the horizontal or ray tracheids only made their appearance after the branch had grown for a number of years. In the late Mesozoic (Cretaceous) marginal ray tracheids have been found in certain American species, investigated in my laboratory, but their appearance was deferred even later than in the pines of the Baltic amber deposits. In our living pines the tracheids are late in appearing in the seedling, and in the root, which is of all plant organs the most conservative, it is often many years before the ray tracheids make their appearance along the margins of the rays in the wood. In the cone or reproductive axis, which has from two to three annual rings, marginal or ray tracheids are usually quite absent. Dr. A. E. Longley has made some very interesting observations on the effect of injury on the wood of the pine. He has discovered that even in the old stem the wood formed after injury is for several years without the marginal ray tracheids. It will be obvious from the above statements that the oldest pines were entirely without ray tracheids in their wood and that after these structures made their appearance they were at first greatly delayed in the late Mesozoic and less so in the early Cenozoic of the Baltic amber pines. In the adult stem of living pines they appear at once in the first year's growth, but they are delayed in the seedling in accordance with the doctrine of recapitulation. Interesting subsidiary doctrines to that of recapitulation are exemplified by the old and interesting genus Pinus, unquestionably the most ancient surviving tree of our northern forests. In accordance with the doctrine of retention of ancestral conditions in conservative organs, we find a similar delay to that exemplified by the seedling of the pines in the root and cone in the appearance of the marginal tracheids. Further, as a result of injury the formation of marginal tracheids may be inhabited for several years and the structure of the wood thus reverts to the ancient condition of organization.

The doctrine of recapitulation is consequently admirably illustrated by our ancient but still living genus Pinus, as becomes clear from a comparison of its younger organization with that of the extinct species of earlier geological times. Further, the evidence derived from a detailed comparison of root and cone or reproductive axis shows that these two organs likewise present features of resemblance to the seedling stem. In other words, root and stem of the adult are conservative organs. These conditions I have described as illustrative of the doctrine of retention of ancestral structures by conservative organs and in the course of my anatomical investigations on other groups of plants from the Calamites

upwards have found to be of wide validity. This doctrine so far as I am aware has not been developed in the case of animals. A very important general principle is that of reversion to extinct types as a result of injury. This condition exemplified by Pinus is of special importance because the reversionary reaction is often the most persistent indicator of former conditions, since it makes itself felt when all other indications of ancestral organization have become obliterated by time. The comparison of living pines with their extinct forbears of the Mesozoic and Cenozoic periods consequently supplies us with three useful working principles. These are, first, recapitulation, which is clearly and strongly supported by the data supplied by living and extinct pines. Second is the doctrine of retention or the doctrine of conservative organs. Finally, we have the doctrine of reversion as a result of injury.

Time-honored candidates for the position of the primitive surviving coniferous group are the Araucarian conifers, at the present time confined to the southern hemisphere but formerly flourishing side by side with the pine tribe or Abietineae in the northern latitudes. The view that the Araucarians are the most primitive living conifers is based on the comparison of the existing representatives of the stock with the Paleozoic gymnosperms. Such a point of view apparently presents the same disadvantages as does a purely classical training for the solution of the practical problems of modern existence. The Paleozoic is too far away to be compared directly with the Cenozoic, and many gross fallacies have been the result of this impossible comparison.

The Araucarian conifers as at present organized are distinguished by generally broad leaves comparable with the Paleozoic Cordaitales. Further the Araucarians have a type of wood superficially quite comparable with that of the Cordaitales, for, as in that group, the pits or valves of the tracheids alternate and the walls of the tracheids in the mature wood are quite without bars of Sanio. The Abietineae or pine subtribe by contrast has needle-like leaves and the tracheids have opposite pits, and bars of Sanio are present in the radial walls of the tracheids of the secondary wood.

Another ancient surviving group is that of the Ginkgoales with a single living representative, *Ginkgo biloba*. Although it is generally admitted that this is a very ancient group comparable with the most ancient of the conifers, it has the same type of tracheids as Pinus, namely, with opposite pits and bars of Sanio. Like Pinus it has also leaves borne on short shoots. Its reproductive anatomy also closely resembles that of Pinus, since the seeds and microsporangia are both borne in twos on the sporophylls and the megasporophyll has inverted fibrovascular bundles, as is the case with the Abietineae. Ginkgo is likewise provided with winged microspores which not only in this feature but also in their internal organizations are in detailed agreement with the Abietineae. A further interesting coincidence is presented by the mode of opening of the microsporangia, which is through the instrumentality of an internal mechanical layer in intimate connection with the fibrovascular system. This situation is all the more significant because the cycads and other lower gymnosperms as well as the ferns effect the dehiscence of their pollen sacs by the action of an epidermal mechanical layer, the annulus. A final interesting and striking point of resemblance between Ginkgo and the Conifers is the presence of "Rotholz." This reddish hued mechanical tissue is recognized as peculiar to the conifers. It is a most significant coincidence that the Ginkgo should be the only other lower gymnosperm to parallel this feature. It seems beyond question that Ginkgo and the Abietineae, particularly Pinus, their most ancient representative, are very closely related. As a consequence, if Ginkgo is an ancient type, as is universally conceded, the same must hold true for the genus Pinus, on the basis of a detailed anatomical agreement. It is expedient to emphasize the important evidence for the close relationship between the Ginkgoales as a preliminary to the further discussion of the Araucarian conifers and the doctrine of recapitulation.

We may now advantageously examine other characteristics of the surviving representatives of the Araucarian conifers. A very striking feature of the two surviving genera, Agathis and Araucaria, is the persistence of the conducting strands to the leaves long after the leaves themselves have fallen. In trunks a hundred or more years old, the foliar traces may still be found in the outer annual rings in regions corresponding to the fallen leaves, which they formerly supplied with water. No comparable feature is found in any other seedplant, and Professor Seward regards this peculiarity as strong evidence for the antiquity of the Araucarian stock. I am free to confess that I am unable to follow Professor Seward's logic in this conclusion, but I think that I am representing his point of view fairly.

An examination of the seedlings of the two genera Agathis and Araucaria in my laboratory has brought to light the interesting fact that although the leaf-traces persist in the old tree indefinitely they are of very short duration in the seedling, lasting only for a few years. This fact becomes of great importance in connection with the study of the fossil forms. Another interesting feature of the young Araucarian stem as well as of the root and cone-axis is the pres-

ence of wood parenchyma. In the Cordaitales no wood parenchyma ever occurs in the secondary wood, and this holds true for the wood of Paleozoic gymnosperms quite generally. Wood parenchyma is only certainly known to occur in Jurassic and later secondary woods. Perhaps the most interesting feature of the organization of the secondary wood in the Araucarian conifers is the occurrence of opposite pitting and bars of Sanio in its first-formed portion. This condition can not be harmonized with the theory of the cordaitean origin of the Araucarian stock, as is the view generally accepted in Great Britain and Germany. The neglect of comparative anatomy on the part of European paleobotanists seems deplorable because no permanently satisfactory conclusion can be reached without a thorough knowledge of the general anatomical structure of the conifers living and extinct, as well as the general principles of anatomical science as applied to all groups of plants.

A commonly emphasized argument for the Cordaitean origin of the Araucarian conifers is the occurrence of quantities of woods of the Araucarian type in earlier geological deposits. My students and myself have made very extensive examinations of the extremely abundant and varied material from the Mesozoic deposits of North America and have not been able to agree that the common European view in regard to the abundance of woods of the modern Araucarian type in Mesozoic deposits. In all our investigations, which cover material from Texas to Dakota and from Washington to Massachusetts, we have found only two specimens of woods of the type of Agathis and Araucaria. In these rare and isolated fossil woods as in the living genera the leaf-traces are persistent. An interesting difference between the mature stem wood of the true Araucarioxyla described by us and that of the living genera is the presence of abundant wood parenchyma. It has been stated above that on the basis of the anatomical structure of the whole organism in the case of Agathis and Araucaria, they must have come from ancestors with well-developed wood parenchyma, although this is lacking in the mature stem wood of the two living genera. We have accordingly pointed out that the term Araucarioxylon must be used in a restricted sense, in view of the general anatomical conditions in living Araucarians. Its use should be confined to woods with indefinitely persisting leaf-traces and well-developed wood parenchyma. If it be objected that comparative anatomical data are not of value, it may be replied that the zoological paleontologists attach great importance to comparative anatomy and it may further be suggested that much of the slight esteem in which botanical paleobotany is at present held is due to the perhaps unnecessarily wooden manner in which it has been developed. It can not be too strongly emphasized that it is impossible to work out the evolutionary position of extinct plants on the basis of the structure of secondary wood alone. If my European paleobotanical colleagues were to moderate by the light of reason their suspicion of what have recently been called "Phylogenetische Abwege," I feel that the results for the science would be happy. In this respect they might well take example from their zoological fellow-workers who have gained much by profitable excursions along phylogenetical byways.

It has become obvious as the result of the investigations of the past decade and a half that most of the woods that have been described as Araucarioxyla are not woods of forms comparable in any strict sense with our two modern genera, Agathis and Araucaria. By far the greater number of woods of the Cretaceous and Jurassic, which a few years ago were universally included under the form genus Araucarioxylon, do not belong there at all.

Nearly twenty years ago, I described for the first time, in collaboration with Dr. Arthur Hollick of Columbia University, the anatomical structure of the important Mesozoic genus Brachyphyllum, which was recognized at that time to be of Araucarian affinities, although not immediately related to Agathis or Araucaria. With the structurally preserved twigs of Brachyphyllum were fragments of wood which showed the same general organization as did the twigs of Brachyphyllum. Some of my European colleagues have at various times objected to the reference of these woods to affinity with the small twigs of Brachyphyllum. The diagnosis has been confirmed in the interval, however, by splitting out small branches from large fossil trunks. The result of the microscopic comparison of the small twigs with their parent axis have entirely justified the conclusions reached at that time on comparative anatomical grounds.

The wood at first referred to Brachyphyllum was three years later erected into a form genus under the generic appellation of Brachyoxylon. This wood presented a number of interesting features. With Araucarian pitting it united the absence of wood parenchyma, non-persistent foliar traces and the presence of traumatic resin canals. The last three features all marked it off very clearly from Araucarioxylon. I believe that this was the first instance in which it has been pointed out that experimental evidence is important in the case of fossil woods. The wound reactions of coniferous woods are often of great diagnostic importance and their significance is just beginning to be realized by my European colleagues.

It is quite obvious that by far the greater number

of so-called Araucarioxyla previously described on this continent and in Europe in reality belong to the genus Brachyoxylon or allied genera and not to Araucarian conifers of the Agathis or Araucaria type. There is an interesting difference of opinion between American and European paleobotanists as to the interpretation of the results. For some unexplained reason my European colleagues have ignored the important genus Brachyoxylon and have invented other and often inappropriate names for other transitional woods described by my students and myself.

Brachyoxylon differs from Araucarioxylon by the absence of wood parenchyma and by its non-persistent foliar traces, as well as by the wound canals which can always be observed in adequate material. Obviously Agathis and Araucaria have come from ancestors which were without persistent leaf traces, since no wood with continuing traces has been described from the lower Mesozoic. This conclusion is likewise reinforced by the evanescent character of the foliar traces in the seedlings of Araucaria and Agathis. Professor Torrey, working up a large collection of Mesozoic and Cenozoic woods, discovered an interesting genus connecting Brachyoxylon and Araucarioxylon, to which he gave the name Telephragmoxylon. This shows the beginning of the formation of wood parenchyma but has the evanescent leaf-traces and the traumatic canals of Brachyoxylon.

The higher members of the Abietineae, such as for example Cedrus, Abies and Tsuga, are in general without normal ligneous resin canals except in the root. When any of these three genera has its wood injured, traumatic resin canals are formed, vertically only in Tsuga and Abies, but both horizontally and vertically in Cedrus. The rational as well as natural explanation of these conditions is that the three genera in question have come from Pinus by reduction and revert under conditions of injury.

Similarly, in the case of Brachyoxylon we have a reversion of an Araucarian type of wood as a result of injury to a condition, resembling, so far as the wound canals go, that found in Abies or Tsuga. Certainly, if we regard Abies or Tsuga as having come from Pinus, we must consider Brachyoxylon as also of Abietineous origin and derived from an ancestry allied to Pinus.

Both in Araucarioxylon and in the living representatives of the Araucarian conifers, we find opposite pits and bars of Sanio *at the beginning of the secondary wood,* a further feature justifying their derivation from Abietineous origin.

It is out of place at this time to go into the question of the evolution of the conifers further. It will be sufficient to point out in conclusion how completely the situation has changed in the past ten years or more in regard to the relative status of the pine-like and Araucarian conifers. Formerly the Araucarian conifers were regarded as preponderant and the Abietineae of slight importance. In the most recent German treatment of the subject six Mesozoic genera of the "Protopinaceae" are described, including thirty or more species mostly transferred from types formerly considered as Araucarian. As a consequence of this procedure the Abietineae become the predominant conifers of the Mesozoic, and the true Araucarioxyla constitute an insignificant remnant. I personally regard the most of these so-called Protopinaceae as forms which have reached the araucarioid condition from abietineous ancestry. The German paleobotanists arrive at the opposite conclusion. It seems unfortunate from their standpoint that they have now to transfer the greater number of coniferous Mesozoic woods, formerly supposed to be Araucarian, to abietineous affinities.

In any case it is highly probable that the logical use of the biogenetic law will in the future clear up this condition of confusion. When the dust of conflict has settled, it will probably appear that Ginkgo and Pinus stand side by side as the prototypes of Mesozoic gymnosperms of cordaitean derivation. It will then be realized that Agathis and Araucaria are aberrant extremes, which merely simulate Cordaites on the basis of extremes meeting but have no near affinity with them. In any case the thesis of the predominance of the Araucarians, in the Mesozoic, must be abandoned, because, by a *reductio ad absurdum,* the German and some other paleobotanists, by their very zeal to save the time-honored Araucarian thesis, are led to refer most of what were formerly regarded as undoubted Araucarian forms to the Abietineae.

The progress of biology along historical lines lends accordingly new support to the already well-documented doctrine of recapitulation. When the doctrine of mutation is relegated to its relatively unimportant position among biological working hypotheses, the great general significance of the biogenetic law or the doctrine of recapitulation will be clearly recognized.

EDWARD C. JEFFREY
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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE COMMITTEE ON THE PLACE OF THE SCIENCES IN EDUCATION

THE following persons have been appointed on this committee, and others are to be added:

Dr. Edna M. Bailey, supervisor of the teaching of science, University High School, Oakland, California. Representative of high schools.

Dr. Jesse B. Davis, professor of secondary education, Boston University. Representative of secondary education in the municipal university.

Dr. Eugene Davenport, dean and professor emeritus, College of Agriculture, University of Illinois, Woodland, Michigan. Representative of agriculture and rural life.

Dr. E. R. Downing, associate professor of natural science, School of Education, University of Chicago. Representative of university school of education.

Dr. Max Farrand, professor of history, Yale University, New Haven, Connecticut, and chairman of the Educational Committee of the Commonwealth Fund. Representative of social sciences.

Dr. R. C. Gowdy, professor of physics, University of Cincinnati. Representative of physics in the university.

Dr. George W. Hunter, professor of biology, Knox College, Galesburg, Ill. Representative of college science teaching.

Dr. V. E. Kellogg, permanent secretary of the National Research Council. Representative of National Research Council, Washington, D. C.

Dr. Harvey B. Lemon, professor of physics, University of Chicago. Representative of university department of physics.

Dr. Burton E. Livingston, professor of plant physiology, Johns Hopkins University, and secretary A. A. A. S., Washington, D. C. Representative of A. A. A. S.

Dr. C. R. Mann, director, American Council on Education, 26 Jackson Place, Washington, D. C. Representative of national education.

Dr. J. Playfair McMurrich, professor of zoology, University of Toronto. Representative of biology in the university.

Mr. John Mills, personnel director, engineering department, and chairman of the College Relations Committee, Western Electric Company, Inc., New York. Representative of electrical engineering.

Dr. Mary S. Rose, professor of nutrition, Teachers College, New York. Representative of household sciences.

Dr. G. M. Ruch, professor of psychology, University of Iowa. Representative of psychological study of science testing.

Mr. S. D. Shankland, executive secretary, Department of Superintendence of the National Education Association, Washington. Representative of National Education Association, Department of Superintendence.

Dr. Frank L. Wade, head of the department of chemistry, Shortridge High School, Indianapolis, Ind. Representative of high schools.

Dr. H. J. Waters, managing editor, *The Weekly Kansas City Star*, Kansas City, Mo. Representative of the public press, and science needs of rural and city life.

Dr. Hanor A. Webb, professor of chemistry, George Peabody College for Teachers, Nashville, Tenn. Representative of teachers college.

Mr. C. M. Wescott, teacher of physics, Hollywood, Cal. Representative of high schools.

The following outline of topics has been placed before the committee. Committee members and others will doubtless add other topics, and will suggest many changes in the statements here made concerning these topics. The outline here presented is designed to serve as basis for discussions and later written comment to be submitted to the whole committee. It is hoped that small discussion groups may meet in various centers, and as a result of the discussion may formulate and submit their written comments to the chairman of the committee.

PURPOSE OF THIS COMMUNICATION

A very important piece of work has been assigned to a committee as shown in the accompanying material. If this committee may have the cooperative efforts of those to whom this communication and later ones are sent, possibly something of value may result. You are asked to read this memorandum and to make constructive suggestions in line with the committee's problems. Please submit suggestions as to opinions, facts or further studies which pertain to the work. If you know of educational studies which bear upon the topic in any way, please bring these to the attention of the committee. In case of each of the organizations of graduate students to whom this memorandum is sent, it is requested that a group conference be held and that a committee of the conference be asked to prepare, and forward to the committee, a report of the suggestions of the conference. Conferences of teachers of science are asked to follow the same procedure.

PURPOSE AND SUPPORT OF THE COMMITTEE

At the meeting of the A. A. A. S., held in Cincinnati, December, 1923, a committee was authorized to study the place of sciences in educational curricula. The members of the A. A. A. S. who initiated this committee desired that, with the unprecedented development of the sciences both in research and in everyday use of science knowledge there should be a somewhat clearer and more widely recognized understanding of the functions of the sciences in current educational programs. It may not be possible to construct the desired statement upon educational and scientific observation and experimentation so to give it a factual basis worthy of the spirit of science, which is the foundation of the association. The committee is, however, charged with the responsibility of investigating and reporting upon the question.

The Commonwealth Fund has provided financial support for initiating this work. Those interested in science education will heartily welcome the interest shown by the officers of the A. A. A. S. and the support provided by the Commonwealth Fund.

PREVIOUS REPORTS REGARDING SECONDARY SCHOOL SCIENCE

In the report of the Committee of Ten in 1893, there appeared very definite statements of objectives and lists of recommended science subjects. This highly valuable report served a useful purpose for the sciences as for other school subjects in the years immediately following its appearance. Science advanced so rapidly, however, that the 1893 report soon became less than an adequate record of accomplishment in science teaching.

In 1913 a National Education Association committee of fifty science teachers began work upon the reorganiza-

tion of secondary science teaching. This committee worked under the guidance of the United States Bureau of Education. Its report appeared in 1920 and was widely distributed. The purposes, outlines of subjects and sequences of subjects as presented in the 1920 report were based upon practices then in use in the more advanced school systems. Since the report was issued the types of courses and sequences advocated have become fairly common. Limitation in time of pupils in which they may take courses in science, and limitation in availability of teachers with desired preparation have prevented many pupils from securing as much instruction in science as thought desirable. Furthermore, the failure of the content, method and organization of science courses to recognize the most insistent needs of modern social, industrial and esthetic living is thought to have kept some of the objectives of the 1920 report from being as widely realized as was expected.

Summaries Regarding the High School Science Situation

The following summaries are presented to show the present situation in representative schools as to sequences of science subjects and relative student registration in each subject.

Sample Summaries of Specific Studies

1. A Summary of the Pennsylvania State Report for 1923 on Status of Sciences in All Four Year High Schools

(a) Of 1,005 high schools general science in 910 schools—Required in 76.9 per cent. and elective in 23.1 per cent. in first year high school; 2.6 per cent. elective in second year high school;
that is, of the 53,904 pupils in general science
53,273 " are in first year.
Of all high school pupils in Pennsylvania in 1923, 26.3 per cent. were studying general science.

(b) Biology in 871 schools—Required in 51.5 per cent. and elective in 48.5 per cent.
29,638 pupils in biology—14.6 per cent. of all high school pupils;
26,881 of these were in second year (10th grade) of the high school;
2,148 in first year of the high school;

(c) Physics in 728 schools—Required in 36.4 per cent. and elective in 63.6 per cent.
19,704 pupils in physics 9.7 per cent. of all high school pupils;
14,216 " " third year (11th grade);
4,800 " " fourth year;
664 " " second grade;
24 " " first year;

(d) Chemistry in 528 schools—Required in 18.2 per cent. and elective in 81.8 per cent.
17,715 pupils—8.7 per cent. of all high school pupils;
10,975 " in fourth year;
6,733 " " third year;
7 " " second year;

(e) Agriculture in 328 schools:
4,003 pupils 1.5 per cent. of all high school pupils.

(f) Physical geography in 88 schools:
3,447 pupils 1.2 per cent. of all high school pupils.

(g) Astronomy in 3 schools:
119 pupils.

(h) Geology, 58 pupils.

(i) In Pennsylvania there was an increase of 19.8 per cent. in the total high school enrollment in the sciences in 1922–23 as compared with 1921–22.

2. Bolton, F. E., "Should physics be required for the university?" *Sch. Rev., 32;* p. 433 (1924).

Table II Distribution of 47,804 high school pupils in Washington in the different science subjects in which they were enrolled.

Physics	4,200	
Chemistry	3,288	
Botany	2,673	6,332
Zoology	1,061	
Biology	1,604	
Physiology	994	
General science	7,802	
Physical geography	1,322	
Geology	54	
Astronomy	2	

3. Science sequences.

The Distribution of the Various Sciences Indicated on the 286 Reports Received 1920–21

Subjects	GRADES									
	7th & 8th		9th		10th		11th		12th	
	No.	%	No.	%	No.	%	No.	%	No.	%
General science	77	26.8	198	68.9	17	5.9	3	1.0	2	0.6
Biology	7	2.4	23	8.0	109	37.9	21	7.3	16	5.4
Botany	2	0.6	36	12.5	98	34.1	36	12.5	24	8.3
Zoology	1	0.3	12	4.1	59	20.6	20	6.9	7	2.4
Physiology	51	17.7	35	12.2	42	14.6	47	16.5	29	10.1
Chemistry	0	0	5	1.7	14	4.8	154	53.6	186	64.8
Physics	1	0.3	7	2.4	38	13.2	180	62.7	148	51.5
Physiography	3	1.0	40	13.9	38	13.2	22	7.6	15	5.2
Geography	7	2.4	24	8.3	31	10.8	18	6.2	14	4.8
Domestic science	6	2.0	11	3.8	9	3.1	5	1.7	5	1.7
Agriculture	11	3.8	4	1.3	10	3.4	7	2.4	5	1.7
Astronomy	0	0	1	0.3	0	0	3	1.0	8	2.7
Psychology	0	0	0	0	0	0	2	0.6	1	0.3

Mr. James A. Keech, teacher of sciences in North Carolina, made a study of the science subjects and their tendency toward a definite sequence arrangement in 286 high schools selected at random through the country. His tabular report is given below:

4. Dr. George W. Hunter, Knox College, Galesburg, Ill., is just completing a study of 274 schools most of which were included in a previous study made by him over 15 years ago. He finds that of the 274 schools reporting, 184 now teach general science in the first year of the four-year high school and that 56 others teach general science in regularly organized junior high school divisions. In the second-year high schools 242 of the 274 teach biology or one of the separate biological sciences. In the third year 150 teach chemistry and 167 physics, and in the fourth year 158 teach chemistry and 135 physics. This study, still unpublished because new data are to be added, shows the same general tendency to adopt a definite high-school science sequence of the type elsewhere set forth.

Help Desired by Those Who Organize Science Sequences

There is a widespread interest in securing a closer relation between science subjects in the different years of schools and junior colleges. A careful study of the results of the many experiments on these questions, a consideration of the inherent relations of science subjects, a study of the amount of time and the conditions involved in science courses, should result in a formulation which might be very generally useful. Such a formulation might prove a guide without fostering the development of a stringent standardization.

Help for Those Who Build Science Laboratories

All know that the science situation in schools and colleges is different from two decades ago. These differences appear in magnitude of the problem, nature of classes, relation of lecture, discussion, laboratory and field work, and in other important points. This would seem to require a study of the appropriateness of the construction designed for use in science work. New types of construction are being devised and their usefulness should be considered and any possible improvements should be made available to all who plan new buildings. The physical provisions should be made to accord with the types of instruction thought to be best.

Further Investigations of Science Teaching Problems

There are many needs for intensive studies on topics related to science teaching. It will prove helpful if the committee may assemble these with brief synopses of their purposes and methods of work, and results when the work has proceeded far enough to be so reported. Also, requests are frequently made for assistance in guiding studies. The committee may not be able to assist in such studies, but the whole question may properly be one for the committee's consideration.

A Synthetic View of Science

There was an early period of the naturalists or natural history men. These had a comprehensive view of science, but few of them were intensive students in any one field of science. They were descriptive scientists in the main.

Then came the period of intensive specialists, which probably must continue even to greater specialization than we now have. But in gaining high specialization we lost general views. We now need a synthesis of sciences, general views, common interpretation of the meaning of science. We need to develop this synthetic interpretation without losing or reducing specialization. Indeed synthesis is essential as a background or a foundation for understanding the necessity and value of high specialization.

May not science secure for many people, both those who are intense students of science and those who study it briefly and broadly, an "appreciation of the universe" which is something beyond mere science knowledge, but no less real. Most teachers teach knowledge, few teach appreciation. May we not come to sense an interlocking of various fields of knowledge, a trained feeling for the value and significance of "things in general" based upon but rising much above the results of our own specific scientific studies. One outstanding scientific critic says: "What always is most astounding to me is that people may know many things of science and still have feeling responses as though the universe were quite different from what they know it to be." Are "college departments busy teaching teachers to teach teachers to teach?" Or are they busy teaching people to be, to see and to respond as truly parts of an appreciative and responsible group who desire scientific truth for the sake of its whole service; not just to record it bit by bit in its proper and logical arrangement with other truths of its own kind. In our necessary separate specialization, have we not reached a point when we must climb upon some sort of vantage position and get the whole landscape again and often? Else the truly engaging general views shall not only be lost but we lose the ability to sense them if they should come.

College Courses in Science

Most college courses in science appear to have been designed as parts of series of courses arranged for those students who are to study a particular science. Students frequently express a desire to study several sciences as part of a whole college program of studies. It is said that college science departments are inclined to regard students as departmental perquisites, once the students have begun to take courses in a given department, and that the departments recommend and urge intensive and technical work in one branch of science, to the inhibition of a general foundation in sciences. Because of these things it is claimed that college students in many institutions regard the science courses as set up for those who already have a start in science subjects.

Teacher Training School Courses in Science

The normal school and teachers college situation is important. In spite of the limitation in these institutions the brief general courses given often provide a general foundation which is very different but probably no worse than the highly differentiated and unbalanced college work in the sciences. Since many secondary school

teachers and other citizens are being educated in these normal schools and teachers colleges in rapidly increasing numbers, it is important that some adequate plan of science instruction be incorporated in those institutions. What can be done or should be done?

Supply of Science Teachers

A larger and better trained supply of science teachers in secondary schools and colleges is needed. Due to the most commendable increases in salaries and the accompanying better social status of science teachers, more men and women are already preparing themselves for science teaching. It is thought that a still higher grade of teachers will be available when there is better understanding of what science as a whole means in current life, and what the different sciences are trying to accomplish.

Publications Popularizing Science

In an age and in a country in which all the people are to have education in so far as they have capacity for it, at a time when science knowledge has made such advances, and when every activity of common life is conditioned by its relations to modern science knowledge, it is important that consistent, prolonged and definitely planned programs be put into operation for adequate popularization of modern science knowledge. The reception by the public of efforts in this direction indicates an encouraging readiness to receive and use such popular and authoritative publications.

Scientific Method in Common Affairs

It seems desirable that there should be presented a series of specific illustrations of how the scientist's method of working may be useful in the common affairs of people in non-scientific pursuits. Being guided by the facts, is now becoming a useful slogan in certain commercial and industrial institutions. The inefficiency which accompanies failure to make a scientific analysis is in contrast with the less wasteful results secured when dependable analyses are made.

Regarding Objectives in Science Teaching

There are many statements of the ends to be sought in science courses. These statements are probably incomplete and certainly are not harmonious. There is needed adequate technique for assembling, classifying and interpreting objectives. If they may not be made harmonious, all points of view may be fairly presented, so that in one report science men may find a well-balanced presentation of the various purposes now held in mind by those who have clearly defined objectives for their work.

What is Modern Science Trying to Do?

What is it which modern science is trying to accomplish? Science is trying to encourage the spirit of inquiry, the desire to know, the ability to ask and answer questions for the sake of answers only as they increase interest and ability in answering other questions. Science recognizes that continued evolution of human mind depends upon the continued use of mind in inquiry, in conclusions, in application, in the establishment of new truth. Science accepts Poincaré's statement that "man is the measure of his own universe."

Science asserts that negative ethics is inconsequential as compared with positive. That a socially working belief that principles are operating to produce results in materials is safer and more hopeful than the older notion that it is merely wrong to act in certain ways. Should not the ethical implications of the scientist's notions of the constant evolution of truth, of the constant relations of cause and effect, the necessity of constant fidelity to true principles, be given a clearer setting so that they may be more readily seen both by persons trained in sciences and those not so trained?

As stated elsewhere, the above paragraphs are designed to suggest topics for consideration by the committee and by any others who are interested in making contributions to the committee's work. These topics are presented for the purpose of giving the committee a start in its work, not to limit or control the committee's work. Please send suggestions to the chairman.

Otis W. Caldwell, *Chairman*
425 West 123rd Street,
New York, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
THE FIFTH WASHINGTON MEETING

Preparations for the approaching Washington meeting of the American Association and associated organizations are approaching completion. The preliminary announcement of the meeting, a booklet of 90 pages, was in the mails before December 1 and should have reached all members long before these notes are published. Lists of the local committees for the Washington meeting have been given in Science for August 29, 1924, and lists of the forty-four societies that are to meet with the association this year have appeared in these pages for August 29 and November 28. The secretaries of the sections and societies have been generally very helpful in sending in material and the announcement presents a better picture of the approaching meeting than has been the case in recent years. Extra copies of the preliminary announcement may be had from the permanent secretary's office by non-members as well as members.

The state of the association is very satisfactory; membership has been greatly increased during the last year. At the time of writing these notes (December 2, 1924) the total number of names on the roll is 13,361. And 8,397 have already paid their dues for 1925. Besides increased membership the asosciation needs increased endowment and increased active, critical and constructive interest on the part of the members and of the affiliated organizations. Especially are members asked to help to increase the number of

life members, sustaining members and donors. The next volume of the Summarized Proceedings, which is to be published next year, is being prepared for. It will contain the directory of members. It may be ordered at a price of $1.50 to members if paid for in advance before next January 1.

One of the outstanding features of the fifth Washington meeting will be the awarding of the second American Association prize of $1,000, which is to be awarded to the author of some noteworthy contribution to scientific advancement presented in the programs of the meeting. Membership in the association will not be considered in making the award.

Besides the opening session on Monday evening, December 29, at which Dr. Charles D. Walcott, secretary of the Smithsonian Institution, will give the retiring presidential address, there will be a number of other general sessions of the association. On Tuesday afternoon, Mr. Austin H. Clark, of the Smithsonian Institution and a member of the Navy Department's Advisory Committee on Oceanography, will give an illustrated talk on the navy's oceanographic program. On Tuesday evening Dr. Frederick Fuller Russell, general director of the International Health Board, will give the third annual Sigma Xi lecture, under the joint auspices of the American Association and Sigma Xi. His subject will be, "War on diseases, with special reference to malaria and yellow fever." Dr. Charles D. Walcott will give an illustrated public lecture on Wednesday afternoon on "Geological explorations in the Canadian Rockies." On Thursday afternoon Professor A. E. Douglass, director of the observatory of the University of Arizona, will give an illustrated public account of the University of Arizona eclipse expedition of September, 1923. A series of motion pictures taken on the western trip following the recent Toronto meeting of the British Association for the Advancement of Science will be shown on Thursday evening by Dr. Edwin E. Slosson, director of *Science Service*. Dr. Willis T. Lee, of the U. S. Geological Survey, will give an illustrated account, on Friday afternoon, of his recent explorations of the Carlsbad Caves of New Mexico.

The plans for a much improved exhibition of research apparatus, methods, books and products have been previously noted in these pages (August 29, 1924). The general exhibition will be located in the gymnasium of George Washington University and there will be numerous special exhibitions in connection with the sessions of the various societies. The Carnegie Institution of Washington invites those in attendance at the meeting to visit its Administration Building, where an exhibition of the work of the institution may be viewed. Many of the government laboratories will be open for inspection. The National Geographic Society is cordially planning entertainment for the geographers. Dr. Chas. A. Shull, of the University of Chicago, is acting as manager of the association exhibition this year, and Mr. W. J. Showalter, of the *National Geographic Magazine,* is chairman of the local subcommittee on exhibition. It is not too late for scientific workers to secure space for exhibiting new research methods and apparatus. It is hoped that exhibits by individual men of science may form an important part of the exhibition this year.

As has been announced, reduced railway rates are to be available to practically every one who will attend the fifth Washington meeting. Virtually the whole of the United States and all eastern Canada are in the region of stations from which the reduced rates apply. Purchasers of tickets to Washington should read carefully the instructions given in the preliminary announcement of the meeting. They are to state that they are going to attend the meeting of the American Association for the Advancement of Science, buying a one-way ticket to Washington and securing a certificate for the American Association meeting. This ticket will be validated after presentation at the registration room in the New Willard Hotel, and it will then entitle the holder to purchase a return ticket at one half the regular fare. It will make no difference whether holders of certificates are members of the association or of associated societies or of other societies meeting with the association this year. To help defray the extra expenses of the Washington meeting a fee of fifty cents will be collected for each railway certificate endorsed and validated. This fee is not for the railway companies but is to help finance the meeting.

The members of the association residing in and near the District of Columbia have been asked for contributions to help defray the large extra expense of this meeting, and very many of them have responded in a cordial and generous manner. Those who come to the meeting will greatly appreciate the generosity and hospitality of the local members.

A list of Washington hotels, with prices, etc., has been prepared by Dr. Albert L. Barrows, chairman of the subcommittee on hotels, and this is published in full in the preliminary announcement. The New Willard Hotel is to be general headquarters for the American Association itself, and many of the other organizations that are to take part in the Washington meeting have arranged for other hotels as their headquarters. Reservations should be made as early as possible. The Washington Young Men's Christian Association and Young Women's Christian Association keep lists of available rooms, which may be secured at rates considerably lower than those of hotels. It is suggested that many of those who attend the meeting may practice a laudable economy by securing

rooms for the week through the above-mentioned sources.

One of the most difficult tasks that confront our local committees when they take up the work of making preliminary arrangements for the annual meetings is that of assigning session rooms to the numerous sections and other organizations that meet with the association. That task has been exceptionally difficult this year because there is in Washington no single group of buildings suitable for housing such a meeting as ours. Dean Hugh Miller, of the Engineering School of George Washington University, has charge of the assignment of meeting places and he has been ably assisted by Mr. Henry F. Haase and the local representatives of the sections. Dean Miller has succeeded in arranging for all the sessions that will occur, but a certain amount of scattering is made necessary by the nature and location of the buildings that are available. The biological groups will meet in the Central High School building, other groups will meet in the rooms of George Washington University, still others in rooms of the U. S. Bureau of Standards, the U. S. Geological Survey, the National Geographic Society, etc.

A publicity office for the approaching meeting is already in operation, in charge of Mr. Austin H. Clark, of the Smithsonian Institution, chairman of the subcommittee on publicity. Our publicity office is again having the great advantage of cooperation from Science Service, whose director is Dr. Edwin E. Slosson. The office will care for the releasing of news items for the use of the newspapers. All who plan to give papers or addresses at the meeting should be sure that Mr. Clark and Dr. Slosson are both supplied *as soon as possible* with manuscripts and abstracts, which will be used in preparing the publicity material. Nothing will be released to the press until the proper time. This feature of the meeting has been dealt with in some detail in SCIENCE for August 29.

The president of the American Association for the Advancement of Science this year is Dr. J. McKeen Cattell, editor of SCIENCE, who is well known to all American scientific workers. The retiring president is Dr. Charles D. Walcott, secretary of the Smithsonian Institution. The vice-presidents and retiring vice-presidents for the sections are as follows, the present vice-president being named first in each case:

Section A (Mathematics): J. C. Fields, University of Toronto; Harris Hancock, University of Cincinnati.

Section B (Physics): K. T. Compton, Princeton University; W. F. G. Swann, University of Chicago.

Section C (Chemistry): F. G. Cottrell, Fixed Nitrogen Research Laboratory, U. S. Department of Agriculture; E. W. Washburn, National Research Council.

Section D (Astronomy): John A. Miller, Swarthmore College; Heber D. Curtis, Alleghany Observatory.

Section E (Geology and Geography): W. C. Mendenhall, U. S. Geological Survey; N. M. Fenneman, University of Cincinnati.

Section F (Zoological Sciences): Edwin Linton, 1104 Milledge Road, Augusta, Ga.; E. L. Rice, Ohio Wesleyan University.

Section G (Botanical Sciences): G. R. Lyman, West Virginia University; C. J. Chamberlain, University of Chicago.

Section H (Anthropology): E. A. Hooton, Peabody Museum; E. A. Hooton, Peabody Museum.

Section I (Psychology): R. S. Woodworth, Columbia University; G. Stanley Hall, deceased.

Section K (Social and Economic Sciences): Thomas S. Baker, Carnegie Institute of Technology; John F. Crowell, 171 Liberty St., Bloomfield, N. J.

Section L (Historical and Philological Sciences): Louis C. Karpinski, University of Michigan; Florian Cajori, University of California.

Section M (Engineering): A. E. Kennelly, Harvard University; John T. Faig, Ohio Mechanics Institute.

Section N (Medical Sciences): William A. MacCallum, Johns Hopkins University; Richard P. Strong, Harvard University Medical School.

Section O (Agriculture): L. R. Jones, University of Wisconsin; R. A. Pearson, Iowa State College.

Section Q (Education): L. A. Pechstein, University of Cincinnati; Henry W. Holmes, Harvard University.

The other officers of the association, the roll of council members and the members of the section committees and other committees are given in the preliminary announcement. There are now 139 members in the council. The council will hold its first session for the Washington meeting at the New Willard Hotel on the afternoon of Monday, December 29, at 2 o'clock.

Space does not allow a detailed account here of the numerous sessions that are being planned by the various sections and societies that will take part in this great gathering of scientists. I must simply refer to the preliminary announcement for this all-important aspect of the meeting. It is of special interest that two newly formed scientific societies will hold their initial meetings with the association this year; these are the History of Science Society (F. E. Brasch, *secretary,* Department of Terrestrial Magnetism, Carnegie Institution of Washington) and the American Society of Plant Physiologists (R. B. Harvey, *secretary,* University Farm, St. Paul, Minn.). The Federation of American Societies for Experimental Biology is to meet with the association this year, which

will greatly strengthen the medical and biological features of the meeting. The special committee on Philological Sciences in the Association (Mark H. Liddell, *secretary,* Purdue University, LaFayette, Ind.) has prepared an excellent program dealing with problems and projects in linguistic research. It is hoped that linguistic scientists as well as those interested in the historical sciences may soon have the advantage of organization in the American Association. The section on Social and Economic Sciences will present a full and important series of invited papers on the general topic, "New problems of Western civilization." The American Political Science Association will this year meet in Washington along with the American Association for the Advancement of Science. The British Ambassador to the United States, Sir Esme Howard, will address the political scientists on "British policy and the balance of power." The Engineering Section will hold sessions on engineering research and the relation of engineering to the fundamental sciences. The recent rapid influx of new association members from among the engineers gives promise of increased activity on the part of this section. The Society of American Foresters will give prominence at the Washington meeting to the newer phases of forestry in the United States and the plans and projects that confront this nation in regard to forests and forest products.

Burton E. Livingston,
Permanent Secretary

SCIENTIFIC EVENTS

NATIONAL PARK MUSEUMS

The national park museum project, begun several years ago with the establishment of a small field collection in Yosemite, has progressed slowly, lacking adequate funds, and has been sidetracked through the absorption of the National Park Service in more pressing problems. The formation of a committee on Museums in National Parks on the suggestion of Stephen T. Mather, director of the service, and the laying of the cornerstone for a new museum in Yosemite National Park on November 16, are important steps in the program.

The museum building was made possible through an appropriation of $70,500 from the Laura Spelman Rockefeller memorial fund. Valuable exhibits already have been collected under the direction of the committee on museums, and plans now being formulated call for a historical and scientific library, and halls to exhibit progressively the geologic development of the Yosemite Valley and the so-called "Life Zones" from the California plains to the summit of the Sierras. It also will serve as headquarters for the Nature Guide System.

This new and modernly equipped institution, which is expected to become one of the nation's greatest treasures of scientific and natural history exhibits, takes the place of a small museum collection begun in 1919 by Ansel F. Hall, park naturalist for Yosemite. He also worked with Mr. Mather in perfecting the Nature Guide System, by which visitors to the national parks see their wonders under expert guidance. The original exhibition was collected and arranged entirely by Mr. Hall, who even made his own exhibition cases by hand, there being no appropriation to purchase needed equipment. The little museum became so popular that it was realized there was a public demand for more adequate showing of the natural park specimens—geologic rock formations, wild flowers and foliage, and specimens of woods found only in certain regions.

The personnel of the Committee on Museums in National Parks which will have charge of this phase of national park development is as follows:

Chauncey J. Hamlin, chairman; Dr. Clark Wissler, curator of anthropology, American Museum of Natural History, vice-chairman; Robert Sterling Yard, executive secretary National Parks Association, secretary; John B. Burnham, president of the American Game Protective Association; Dr. H. C. Bumpus, of Brown University; Laurence Vail Coleman, secretary of the American Association of Museums; Dr. A. R. Crook, chief of the Illinois State Museum; Dr. Vernon Kellogg, secretary of the National Research Council; Dr. Frederic A. Lucas, honorary director, American Museum of Natural History; Dr. John C. Merriam, president of the Carnegie Institution of Washington; George D. Pratt, vice-president of the Brooklyn Museum of Arts and Sciences, and Professor Charles L. Richards, director of the American Association of Museums.

TANNING RESEARCH LABORATORY AT THE UNIVERSITY OF CINCINNATI

Among the activities which marked the annual meeting of the Tanners Council of America at Cincinnati, from November 18 to 20, was the dedication of the council's new research laboratory. Here the studies of the fundamentals of leather manufacture that have been made by Professor G. D. McLaughlin will be continued and extended. Professor McLaughlin, as director of the laboratory, assisted by E. R. Theis, in charge of chemical work; Dr. G. E. Rockwell, in charge of bacteriological work, and Daisy M. Baehr, histologist.

The laboratory is on the grounds of the University of Cincinnati and the funds for its establishment, approximately $110,000, were raised by the Tanners Council. On Wednesday, November 19, the members

of Tanners Council and the American Leather Chemists Association were welcomed by Dr. Frederick C. Hicks, president of the University of Cincinnati. In the absence of Secretary Hoover, Dr. Martin H. Fischer spoke on the significance of this undertaking. He was followed by Dr. J. S. Rogers, president of the American Leather Chemists Association. President Fraser M. Moffat, of Tanners Council, then presented the laboratory to the University of Cincinnati and it was accepted on behalf of the directors by President Hicks.

In the three-story brick building there are laboratories well equipped for fundamental research on all phases of leather. The large staff laboratories are supplemented by smaller ones for students who have qualified themselves to do special work. The whole undertaking is an example of cooperative fundamental research fostered by an industrial association.

LABORATORY FOR THE STUDY OF THE PHILOLOGICAL SCIENCES AT THE UNIVERSITY OF MICHIGAN

Dr. A. R. Morris, of the department of rhetoric in the University of Michigan, has sent the following communication to Professor Alfred H. Lloyd, dean of the graduate school of the university:

I am directed to report to you the action of a conference of representatives of seven departments held yesterday to consider plans for mobilizing resources in the interest of laboratory study of phonetics, philology and language form. The movement grows out of a proposal made last December before the Philological Section of the American Association for the Advancement of Science by Professor Cottrell. The suggestion seemed so timely that it ought not go unrealibed.

To meet the needs of philologists not provided with laboratories, it was suggested that a laboratory be established, somewhere in the country, equipped to make records for all comers. Such a laboratory adequately fitted and manned involves greater expense than any institution is just now in a position to meet. Until a way is found through the National Research Council or otherwise to provide such facilities, or until some other feasible plan is worked out, it seemed that something might be done immediately in this direction by pooling the laboratory resources of equipment and personnel. After some preliminary conferences seven departments have taken steps to pool their resources and to offer their combined equipment to any one wishing to make speech records for analysis. By this combination we should be able soon to provide facilities for recording by any of the methods so far developed and to provide material assistance in the analysis of curves for the study of tone quality.

The seven departments cooperating are psychology, physics, rhetoric, physiology, phonetics, mathematics and public speaking. Our proposal is, perhaps, only a stopgap to serve until something better is developed, but so far as this plan can be made to advance the laboratory study of linguistic problems these seven departments are glad to offer their services.

CHEMISTRY AT THE WASHINGTON MEETING OF THE AMERICAN ASSOCIATION

An interesting program will be presented to the chemists at the Washington meeting of the American Association for the Advancement of Science, beginning on Tuesday, December 30, at 10 A. M. The meeting is under the auspices of the Washington and other eastern sections of the American Chemical Society and Section C of the association, but all chemists and others interested are invited to attend.

The address of the retiring vice-president of the association, Dr. E. W. Washburn, editor of the International Critical Tables, will be presented on Wednesday afternoon on the subject "Some effects of the weather upon physical measurements."

A symposium on X-rays in chemistry has been arranged, and will probably be held on Thursday afternoon. Dr. Arthur H. Compton will present an illustrated paper on X-rays and their scattering by electrons; Dr. Ralph W. Wyckoff, of the Geophysical Laboratory, will consider the topic "X-rays and crystal structure"; Dr. W. P. Davey, of the General Electric Company, will talk on "Atomic and ionic radii," and Dr. George L. Clark, of the Massachusetts Institute of Technology, will give a paper on "The versatility of x-rays."

A few of the other papers to be presented are listed below:

Illustrated lecture on gels and colloids, H. N. Holmes, Oberlin College.

European laboratories, W. A. Noyes, University of Illinois.

Excited atoms, K. T. Compton, Princeton University.

New aspects of some fundamental properties of matter, Eugene C. Bingham, Lafayette College.

A method of establishing a potential gradient for organic radicals, M. S. Kharasch, University of Maryland.

The electronic conception of adsorption from the standpoint of gels, Neil E. Gordon, University of Maryland.

Some causes of volcanic activity, A. L. Day, Geophysical Laboratory.

The interpretation of band spectra, Robert S. Mulliken, Harvard University.

The relation between the static and the dynamic concepts of the atom, Harold C. Urey, Johns Hopkins University.

Influence of sulphur on the color of dyes, E. Emmet Reid, Johns Hopkins University.

Electric moments of molecules, Charles P. Smythe, Princeton University.

Catalysis in homogeneous systems, F. O. Rice, Johns Hopkins University.

Methods for the determination of densities, M. Haring, University of Maryland.

The present status of thermochemical data, F. Russell Bischowsky, Johns Hopkins University.

The status of the electron in the teaching of chemistry, Neil E. Gordon, University of Maryland.

Errors in experimental work as illustrated by determinations of surface tension, T. F. Young and W. D. Harkins, University of Chicago.

The complete program will be published later.

On Tuesday afternoon the chemists will meet with the physicists and the astronomers.

Hotel Raleigh has been chosen as headquarters for the chemists.

WILLIAM D. HARKINS,
Secretary of Section C

SCIENTIFIC NOTES AND NEWS

DR. K. T. COMPTON, professor of physics in Princeton University, has been elected chairman of Section B (Physics) of the American Association for the Advancement of Science and association vice-president for that section, to fill the place left vacant by the death of Dr. Ernest Fox Nichols.

DR. WILLIAM F. DURAND, professor emeritus of mechanical engineering in Leland Stanford University, was installed as president of the American Society of Mechanical Engineers on December 2. Vice-presidents chosen for the coming year are Sherwood F. Jeter, of Hartford, Conn.; Professor Robert W. Angus, of Toronto, and Thomas L. Wilkinson, of Davenport, Ia.

DR. HUGH K. MOORE, director of research, the Brown Company, Berlin, N. H., has been awarded the Perkin Medal for 1924 in recognition of his chemical engineering attainments in the fields of salt, sulphur and cellulose. It will be presented at the meeting of the New York section of the Society of Chemical Industry on February 6.

DR. CHARLES S. SARGENT, director of the Arnold Arboretum, has been awarded the Lodor Rhododendron Cup of the Royal Horticultural Society of England.

THE first presentation of the new Holley Medal of The American Society of Mechanical Engineers has been made to Hjalmar Gorrfried Carlson, of Worcester, Mass., "for his invention and processes which made possible the timely production of drawn steel booster castings for artillery ammunition, thereby aiding victory in the World War."

IN connection with the annual meeting of the Indiana Academy of Sciences, held at Purdue University on December 5, a dinner was given in honor of Dr. J. C. Arthur and Dean Stanley Coulter. Addresses were given by Dr. John Merle Coulter, of the University of Chicago, and Dr. William Trelease, of the University of Illinois.

RAMON Y. CAJAL, professor of histology at the University of Madrid, has had conferred upon him an honorary degree by the University of Paris.

PROFESSOR C. F. CURTIS RILEY, connected with the department of zoology at the University of Manitoba, formerly of Syracuse University, New York, has been elected a fellow of the Entomological Society of London.

THE Langley Memorial Prize of the London School of Hygiene and Tropical Medicine has been awarded to Dr. P. S. Selwyn-Clarke, of the West African Medical Service, for his monograph on small-pox in the negro and negroid tribes of British West Africa.

PROFESSOR FRANCIS VEJDOVSKY, senior of Czech zoologists, and formerly professor at Czech University in Prague, celebrated his seventy-fifth birthday on October 24.

EDOUARD BRADLEY, pioneer French worker in wireless telegraphy, celebrated his eightieth birthday on November 8.

PROFESSOR ETHAN ALLEN SHAW, for twenty-five years professor of mathematics at Norwich University, will retire at the close of the present semester.

M. ALBIN HALLER, professor of organic chemistry, and M. Joannis, professor of chemistry at the University of Paris, have retired.

PROFESSOR A. BIEHL has retired from the Astrophysical Observatory at Potsdam, having reached the age limit, and Dr. Baron von der Pahlen has been appointed to take his place.

IT is announced that Dr. Aldo Castellani, director of the department of tropical medicine at the Ross Institute, London, has been offered the directorship of the new School of Tropical Medicine at Tulane University, New Orleans.

PROFESSOR M. DOELLO-JURADO, of the University of Buenos Aires, has been appointed director of the National Museum of Natural History at Buenos Aires.

MARTIN FROBISHER, JR., for the past three years with the Maryland State Health Department, has been appointed chief, division of chemistry, Baltimore City Health Department.

C. E. BALES, who is president of the Louisville Section of the American Chemical Society, has been made assistant manager, in charge of production, at the Louisville Fire Brick Works.

UPON invitation from Dr. A. A. Noyes, Dr. J. J. Abel, professor of pharmacology at the Johns Hopkins University, has gone to the California Institute of Technology at Pasadena to try to isolate the active principle in insulin by methods used on pituitary extract. Dr. E. M. K. Geiling, of the university, ac-

companied Dr. Abel. They will return about March 1, 1925.

DR. A. L. BLOOMFIELD, associate professor of medicine, and Dr. A. Keidel, associate professor of clinical medicine, have been given leave of absence by the Johns Hopkins University for one year to study abroad in European clinics.

DR. ELIOT JONES is taking a year's leave of absence from Stanford University and is serving as professor of railway transportation on the McKinley Foundation at the University of Illinois.

DR. P. H. ROLFS and family returned to the United States on December 8 for a short vacation. Dr. Rolfs has been employed by the State of Minas Geraes (Brazil) for the last four years, in the construction and organization of an Agricultural College on the North American plan. He will remain in the United States until about March 15, and will then return to Minas Geraes for another period of four years. His headquarters while in the United States will be in Gainesville, Florida. The site of the Agricultural College is at Viçosa, on a plateau over six hundred meters high, in the Sao Geraldo Mountains. The main building is approaching completion and the experimental grounds are well developed.

DR. S. Z. DE FERRANTI has returned to England after a tour of the United States and Canada. At the conclusion of the tour on November 6, a luncheon was held at the Yale Club, New York, in honor of Dr. Ferranti. The luncheon was given under the auspices of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Institute of Electrical Engineers.

A GROUP of five physicians from Central Europe holding fellowships under the division of medical education of the Rockefeller Foundation arrived in the United States November 20 for graduate study in preparation for medical teaching in their own countries. Three of the physicians, Dr. Slavko Pejich, Dr. Urosh Ruzitchitch and Dr. Radoji Taditch, are from Yugoslavia; one, Dr. Andrew Bosanyi, is from Hungary, and one, Dr. Leopold Schonbauer, is from Austria.

MISS MARY BEARD, formerly director of the Instructive District Nursing Association of Boston, sailed on November 29 for England, where she will conduct, under the auspices of the division of studies of the Rockefeller Foundation, a survey of maternity care with special reference to the relation of midwifery to nursing.

DR. C. A. BROWNE, chief of the bureau of chemistry of the United States Department of Agriculture, will speak on the subject of "Past and future of agricultural chemical research" before the regular meeting of the New York section of the American Chemical Society at Rumford Hall on December 12.

DR. A. E. DOUGLASS, professor of astronomy at the University of Arizona, gave an illustrated lecture entitled "Cycles in development of tree rings as an evidence of climatic variation," at the Carnegie Institution of Washington, on December 5.

DR. FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution of Washington, in Boston, recently gave a lecture on "The measurement and significance of basal metabolism" at a number of universities and medical schools in the middle west. This lecture tour was under the auspices of the Mayo Foundation. During the week of November 17–22 Dr. Benedict addressed audiences at the University of Wisconsin, the Mayo Clinic, the University of Minnesota, the Medical School of the University of Nebraska, the Washington University Medical School and the University of Iowa.

AT the University of Arizona during the week of November 17 to 21, Dr. F. W. Upson, of the University of Nebraska, gave a series of five experimental lectures on the chemistry of colloids. He also spoke at the university assembly on the relation of chemistry to medicine.

DR. JOHN W. GOWEN, of the Maine Agricultural Experiment Station, Orono, addressed the scientific staff of the Rockefeller Institute for Medical Research on December 5 on "The secretory activity of the mammary gland and some of its problems."

ON November 22 Dr. Arthur Willey, F.R.S., of the department of zoology of McGill University, Montreal, delivered an address to the Royal Canadian Institute, Toronto, on the subject "A trip to the great lake Mistassini."

DR. THEODORE HOUGH, dean of the medical department and for seventeen years professor of physiology at the University of Virginia, has died at the age of fifty-nine years.

DR. ALFRED HULSE BROOKS, for twenty years chief of the Alaskan division of the U. S. Geological Survey, died on November 21, aged fifty-three years.

PROFESSOR SPENCER AMBROSE BEACH, vice-dean of agriculture and professor of horticulture at Iowa State College, died on November 2, in his sixty-fifth year.

DR. JOHN B. ROBERTS, formerly professor of surgery at the University of Pennsylvania and a former president of the American College of Surgeons, died on November 29, aged seventy-two years, from injuries received when he was struck by an automobile.

DR. RUDOLPH MENN, Chicago surgeon, formerly

dean and vice-president of Jenner Medical College, died on December 3.

THE Biological Club of the University of Minnesota held its two hundredth meeting on October 20. Dr. B. H. Blackman, of the Imperial College of Technology, London, was a special guest of honor. Other special guests included President L. D. Coffman, Dean Guy Stanton Ford, of the graduate school; Dean E. P. Lyon, of the medical school; Dean J. B. Johnston, of the college of science, literature and arts, and Dean W. C. Coffey, of the department of agriculture, all of the University of Minnesota.

THE Washington Section of the American Chemical Society held its annual election on November 13, selecting L. H. Adams as president, R. Gilchrist as secretary and H. W. Houghton as treasurer. Newly elected members of the executive committee are: Wm. Blum, V. K. Chesnut, R. B. Sosmann, M. X. Sullivan, E. W. Washburn and E. T. Wherry; Councillors: F. G. Cottrell, W. M. Clark, S. C. Lind and R. S. McBride. Preceding the meeting a dinner was given in honor of Dr. E. F. Armstrong, a prominent British industrial chemist and formerly president of the Society of Chemical Industry. At the opening of the meeting Dr. Armstrong spoke for a few minutes on the present trend in chemistry, stressing particularly the work now in progress in catalysis and surface phenomena and predicting great advances in the near future.

UNIVERSITY AND EDUCATIONAL NOTES

PORTER L. NEWTON, of Waltham, has given the residue of his estate to the Massachusetts Agricultural College to be used through the awarding of scholarships designed to promote and improve the agricultural situation in the state. The gift will probably amount to about $25,000.

THE Carnegie Corporation has given to Dalhousie University the sum of $190,000. Of this amount $90,000 will go toward payment of accumulated deficits, while the remainder will be divided into five annual payments of $20,000 each as a fund to forestall future deficits.

WE learn from the *Journal* of The American Medical Association that many prominent Japanese and Chinese officials attended the recent opening of the medical school of the Chingtao Hospital, which has been erected by the Japanese government, says the *Japan Medical World,* as one of Japan's enterprises for the education of Chinese students. The school will be maintained by the hospital and by a subsidy of 140,000 yen per annum from the Japanese government.

THE cornerstone of the new buildings of the University of Brussels was laid on November 20. The new building has been made possible by financial assistance, amounting to nearly 20,000,000 francs, given by the Commission for Relief in Belgium and the Educational Foundation. The American Relief Commission provided food for the Belgian population during the German occupation, and the 20,000,000 francs have been paid out of the balance remaining over from the fund.

DR. A. H. RYAN, formerly professor of physiology at Tufts College Medical School, Boston, has been appointed professor of physiology at the University of Maryland School of Medicine and the College of Physicians and Surgeons, Baltimore.

DR. W. L. HOLMAN, associate professor of bacteriology at the Johns Hopkins University, has been appointed associate professor at the University of Toronto Medical School.

L. J. PESSIN, PH.D. (Johns Hopkins, 1923), has accepted a position as assistant professor of plant physiology at the North Carolina State Agricultural and Mechanical College.

A. W. BELLAMY recently resigned his position as assistant professor of zoology at the University of Chicago and went to the University of California, southern branch.

AT Tufts Medical College, Dr. Frank Howard Lahey, professor of surgery, and Dr. Charles Davison Knowlton, assistant professor of theory and practice of medicine, have resigned.

ABRAHAM PRESS, at one time demonstrator in physics and mathematics at the Southwestern Polytechnic Institute, London, and recently technical science expert, Interdepartmental Radio Board, Washington, D. C., sailed for Siam on December 3 *via* Europe to accept the post of professor of physics in the premedical school of Chulalongkorn University, Bangkok.

DR. BETHE, professor of physiology at the University of Frankfurt, has been called to take the place of Dr. Rudolph Metzners, retiring professor at the University of Basel.

DISCUSSION AND CORRESPONDENCE

GENERAL PLAN FOR MAGNETIC AND ALLIED OBSERVATIONS DURING THE TOTAL SOLAR ECLIPSE OF JANUARY 24, 1925[1]

SPECIAL magnetic and allied observations will be made at stations in or near the path of totality of the solar eclipse of January 24, 1925, by the Depart-

[1] Communicated at the request of the director of the Department of Terrestrial Magnetism.

ment of Terrestrial Magnetism of the Carnegie Institution of Washington, and by various cooperating magnetic observatories, institutions and individuals. One magnetic observatory, that at Agincourt, near Toronto, Canada, lies within the shadow belt. The Coast and Geodetic Survey magnetic observatory at Cheltenham, Maryland, is also very favorably situated, being within 200 miles of the southern edge of the path. The observatories of Great Britain lie near the path, although the sun will set while still eclipsed at those stations.

The general scheme of work is as follows:

1. *Simultaneous magnetic observations* of any or all the elements, according to the instruments at the observer's disposal, every minute from January 24, 1925, 11^h 58^m to 18^h 02^m Greenwich civil mean time.

(To insure the highest degree of accuracy, the observer should begin work early enough to have everything in complete readiness in proper time. *Past experience has shown it to be essential that the same observer make the readings throughout the entire interval.* If possible, similar observations for the same interval of time as on January 24 should be made on January 23 and 25.)

2. At *magnetic observatories* all necessary precautions should be taken to insure that the self-recording instruments will be in good operation not only during the proposed interval, but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient. (*It is recommended that, in general, the magnetograph be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible be taken to guard against instrumental changes likely to affect the continuity of the base-line.*)

3. *Atmospheric-electric observations* are desirable to the fullest extent possible with the available equipment and personnel. Observations of potential gradient are most easily provided for and most conveniently taken; in addition to these, observations (preferably for both signs) of either conductivity or ionic content are also very desirable. Full notes regarding cloud and wind conditions and, if possible, observations for both temperature and relative humidity should accompany the atmospheric-electric observations. These observations should cover the same interval as the magnetic observations. The value of the observations on the day of the eclipse will be greatly increased if similar observations can be made during the same time of day on two or three days before and after the eclipse.

4. *Meteorological observations* in accordance with the observer's equipment should be made at convenient periods (as short as possible) through the interval. It is suggested that, at least, temperature be read every fifth minute (directly after the magnetic reading for that minute).

5. *Observers in the belt of totality* are requested to take the magnetic reading every 30 seconds during the interval, 10 minutes before to 10 minutes after the time of totality, and to read temperature also every 30 seconds, between the magnetic readings.

J. P. Ault
H. W. Fisk

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Washington, D. C.

A METHOD OF MAKING PERMANENT SMEARS OF POLLEN MOTHER CELLS

In some recent work on *Ginkgo biloba* excellently fixed preparations of pollen mother cells in mitosis were obtained by the rapid and simple method outlined below. The desired stage of the anthers was determined by Belling's aceto-carmine method (Belling, J. (1921) *American Naturalist* 55: 573–4). A very thin film of albumin fixative was spread on a slide; then the anther was crushed and its contents distributed upon the slide with a scalpel as evenly as possible. When this was done, the slide was placed in a Coplin jar containing Flemming's medium fixative for 24 hours, washed 5 hours in running water, bleached in hydrogen peroxide and dehydrated and stained with safranin and light green. This method seems worth testing on other plants, since with it permanent records can be kept of material which has been studied by Belling's method. Such records are exceedingly useful for demonstration purposes, since even if the desired plants are in good condition, which can not always be the case, considerable time is consumed in making new preparations for each visiting scientist who wishes to see the actual material described in some published work.

Margaret C. Mann

University of California

OSMOSIS DEMONSTRATION FOR CLASSES IN BIOLOGY

In the article, "Osmosis demonstration for biology classes," by Mr. Benjamin C. Gruenberg (Science, LX, 1555, October 17, 1924), there is described a very excellent method for preparing celloidin bags for this demonstration. There is just one addition to this method, which our technician has found a big assistance.

This is in the preparation of the bottles before

the "new skin" or celloidin is poured into the bottles. This consists of covering the inside of the bottle with a ten per cent. solution of molasses and water. The molasses solution film is allowed to thoroughly dry on the inside of the bottle, before coating the inside of the bottle with the celloidin film. The celloidin film can very easily be removed by simply immersing the bottle in water as this will dissolve the film molasses coating on the bottle.

The only precaution necessary is to be sure that the ether of the celloidin solution has been thoroughly removed before the water is added. As pointed out, the ether will have sufficiently evaporated when the odor of ether is gone.

Our technician has found this a great time-saver; it also eliminates the danger of breaking the bag in removing it from the bottle.

M. W. Welch

W. M. Welch Scientific Company,
Chicago, Illinois

HEARING IN A NOISE

Referring to the letter of Dr. G. W. Boot, in Science of October 17, it seems that many cases of enhanced acuity of hearing of deaf people in the presence of a noise, including one of the cases cited by him, are really cases of greater ease of conversation with a normal hearing person. These may be explained by the fact that the noise bothers the deaf person less than the normal person, due partly to the difference in the levels of loudness to which they are sensitive and partly to the difference in frequency between the noise and the speech, the deaf person being more deficient for the noise frequencies than for the speech frequencies. As Dr. Boot points out, it is people with fixation of the stapes who report the phenomenon, and these people are deaf at the lower frequencies, which is the region of probably most disturbing noises.

I would like to call attention to the desirability of having the test made which was suggested in the March issue of the *Annals of Otology, Rhinology and Laryngology*. If the hearing itself is improved in the presence of a noise, as Dr. Boot maintains, then two such people with similar deficiencies in hearing should be better able to converse *with each other* in noisy surroundings, while if the change usually noted by them is due to the change in loudness with which normal hearing people talk in a noisy place, as is suggested above, then the two deaf people should not find the noise to be of any benefit. It is hoped that some one with clinical material available may try this experiment.

F. W. Kranz

Riverbank Laboratories
Geneva, Illinois

SPECIAL ARTICLES

INFLUENCE OF ULTRA-VIOLET LIGHT ON YOUNG LAYING HENS

We have found ultra-violet light to have as much effect on the egg production in young laying hens as it has on the bone development in young growing chicks. It is very common for young laying hens, when kept in the absence of ultra-violet light, and on a feed low in the anti-rachitic vitamin, the condition that tends to produce rickets (leg weakness) in growing chicks, to develop a pathological condition characterized by the following symptoms:

(1) The egg production is low.

(2) The eggs produced have very thin shells.

(3) The whites and yolks have less calcium and phosphorus than normal eggs.

(4) A much smaller percentage of these eggs hatch than normal eggs.

(5) Fully developed eggs are often retained in the oviduct, for three or four days.

(6) The hens often develop lameness or paralysis of the legs or wings.

(7) The bones become low in their mineral content and are easily broken.

(8) The calcium and phosphorus content of the blood is below normal.

That ultra-violet light will prevent the above condition is shown by the following experiment which we conducted last winter.

Two lots, of twelve Leghorn pullets each, were placed in the nutrition laboratory October 1, 1923. They were given the same ration, which consisted of yellow corn 82 per cent., tankage 5 per cent., casein 5 per cent., butter fat 5 per cent., bone ash 3 per cent., all ground together in a mash, and all the sprouted oats and oyster shells they would eat.

A cockerel was placed in each pen the first of January. Once a week these cockerels were shifted from one pen to the other in order to reduce, as much as possible, the influence of the male on the hatchability of the eggs from the different pens.

Beginning January 23 the hens in Pen I received a ten-minute ultra-violet light treatment each day during a period of sixteen weeks. During the period before the light treatment of Pen I was begun, there was no significant difference in the egg production of the two pens. The light treatment had a very marked effect on the egg production which showed up during the first week it was used.

During the sixteen-week period, in which Pen I received the ultra-violet light, the hens laid 497 eggs, while those in Pen II laid only 124 eggs. The eggs in Pen I had about 30 per cent. more calcium in the shell, and 5 per cent. more in the contents (whites and yolks) than the eggs in Pen II. Eggs from Pen I had an average hatchability of 78 per cent.,

while the hatch for those in Pen II was only 40 per cent. The leg weakness and retention of eggs in the oviduct began to be manifested in Pen II about the middle of the sixteen-week period. During the last half of this period six of these hens died. These hens all contained ruptured egg yolk.

On May 12 the light treatment was discontinued on Pen I, and June 1 light treatment was begun on Pen II. When this change was made, the previous record was just reversed. No more hens died in Pen II, and they increased in egg production, while Pen I decreased in egg production. The percentage produced in Lot I fell from 48 per cent. during the sixteen-week light treatment to 23 per cent. during the ten-week period when they received no light treatment. The percentage produced in Pen II increased from 11 per cent. during the sixteen-week period they received no light treatment to 34 per cent. during the ten weeks they received the light. During the period that Pen I received the light treatment, the shells on the eggs weighed 44 per cent. more than those in Pen II. When the light was changed to Pen II the weight of the shells from this pen was 12 per cent. greater than those from Pen I.

These data indicate that the ultra-violet light caused the difference noted between these two pens.

J. S. Hughes
L. F. Payne
Kansas State Agricultural College
Manhattan, Kansas

THE AMERICAN CHEMICAL SOCIETY

Division of Chemistry of Medicinal Products

Executive Committee

E. H. Volweiler, *chairman,* H. A. Shonle, *secretary,* E. B. Carter, F. O. Taylor.

The effect of some guanidine derivatives and other related substances upon the blood sugar of normal rabbits: Harry E. Dubin and H. B. Corbitt. In line with Collip's suggestion that insulin might be a guanidine compound, a number of derivatives were tested out for their blood sugar-reducing effect. While a reduction in blood sugar was obtained, it was necessary to use a comparatively large dose. As a result, the animals died; besides, the decrease in blood sugar was not at all comparable to that produced by a unit of insulin. It seems unlikely that insulin is a guanidine compound.

Relationship between chemical structure and physiological action. The effect of 1-suprarenin (synthetic epinephrin) and various derivatives upon the blood sugar of normal rabbits: Harry E. Dubin, H. B. Corbitt and Louis Freedman. Rabbits were prepared for use in a manner similar to that employed in testing insulin. Definite amounts of 1-suprarenin and various derivatives were injected and the blood sugar noted at stated intervals. The blood sugar-increasing effect varied with the chemical configuration of the substance injected. Frequently, the rise in blood sugar was followed by a decrease below the normal. This is undoubtedly only a compensation for the previous rise and has no further significance.

The establishment of chemotherapeutics: H. M. Spencer. Chemotherapy has been defined and its limitations enunciated. It has been demonstrated that chemotherapy is a part of physical chemistry rather than of organic chemistry. A new medicament, Mercodel, has been described, the therapeutic vigor of which exemplifies this fact. Chemotherapy should concern itself at least equally with the energy in the body as with the material changes. The limitations of animal experimentation must be recognized, but the value of a comparative study of disease in organic life will lead to most fruitful results. Chemotherapy must contribute to a science of comparative medicine that should shed as much light upon human diseases as comparative morphology has thrown upon an understanding of human evolution.

Mercury derivatives of some carbonyl compounds: Edward Lyons. New mercury compounds of several imids and their preparation are described. In these, the mercury joins the molecule through the carbonyl group, and in the case of saccharin, the SO_2 group functions as if 2 CO groups were present. Succinimide and phthalimide yield mono- and di-mercury compounds, saccharin yields mono-, di- and tri-mercury compounds.

The effect of glucose upon the toxicity and therapeutic efficiency of arsphenamine: George W. Raiziss, M. Severac and A. Kremens. In 1917, Kopaczewski suggested the adding of glucose to solutions of arsphenamine in order to prevent immediate reactions, such as nitritoid crises, which sometimes follow the intravenous administration of the drug. It was found by others that glucose generally decreases the toxicity of arsphenamine and its derivatives. It has also been found that solutions of these drugs can be made more or less permanently stable if glucose is added. The authors found that chemical combination takes place between arsphenamine and glucose and they isolated such compounds. These authors further found that the addition of glucose solution decreases the toxicity of arseno compounds, but it diminishes their therapeutic efficiency to still greater extent. The therapeutic efficiency was tested on the albino rat infected with trypanosoma equiperdum.

Studies of the vitamin potency of cod liver oils—XIII —The vitamin A potency of dogfish liver oil: Arthur D. Holmes and Madeleine G. Pigott. Commercial fishermen have raised the question as to the value of dogfish liver oil as a source of the fat-soluble vitamins. To secure information in this connection, dogfish liver oil was prepared from average, mature fish of both sexes. The vitamin A potency of this oil was tested under the same laboratory conditions as employed for testing the vitamin A potency of cod liver oil. It was found that one milligram daily of this dogfish liver oil contained sufficient vitamin A to restore growth and health in albino rats suffering from vitamin A malnutrition.

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MEDICAL ZOOLOGY AND HUMAN WELFARE[1]

EVERY one is more or less familiar with the relation of medical zoology to human welfare, but many of us do not realize what a very great influence both the scientific and practical phases of this subject have had upon our daily lives and upon the progress of the human race. Medical zoology is the subdivision of the great science of zoology which deals with groups of animals selected on the basis of their intimate association with man. Certain of these animals, such as scorpions and snakes, are of medical importance because of their venomous bites; others, such as certain game animals of Africa that harbor the germs of sleeping sickness, act as reservoirs from which transmitting agents obtain their infections; and some animals carry as external parasites the transmitting agents themselves, such as the rat which is infested with plague fleas. Zoologically the principal group with which medical zoologists are concerned are the parasitic protozoa, parasitic worms and the insects that may transfer these organisms as well as bacteria and filterable viruses from an infected to an uninfected animal. Since most of these organisms are parasites the terms medical zoology and parasitology are often used synonymously.

Medical zoologists do not limit themselves to the study of those parasites or insects that have been proved to be directly concerned in human diseases but investigate also the parasites of lower animals and plants, since these are usually more easily obtained for experimental work and often belong to the same genera as do the human parasites; hence the results of their study can be translated more or less directly into terms of human parasitism. It may be worth while at this point to define a parasite and separate parasites into their several categories. A parasitic animal is one that lives on or in and at the expense of another animal or plant; the latter is called the host. In many cases animals or plants are closely associated together, one partner benefiting by the association, whereas the other is neither injured nor benefited. This condition is known as commensalism. Again, two closely associated organisms may be mutually beneficial and sometimes one is unable to live without the other. This type of partnership is known as symbiosis. In a third cate-

[1] A lecture delivered at Mt. Holyoke College on November 14, and at Mount Union College on November 19, 1924.

gory belong the true parasites which always injure their host. Some of these are ectoparasites; they live on the outside of the body, and are, to a certain extent, independent of their hosts; among these are insects such as bedbugs, lice and fleas. Others, called entoparasites, succeed in entering the body, where they usually become located in a particular organ or tissue; for example, the dysentery amoeba lives in the intestine, the malarial parasites in the red blood corpuscles and the trichina worms in muscle. The lives of many of these parasites are not particularly happy, since their life-histories are often extremely complex and the conditions that they must contend with in order to maintain themselves and continue their race are such as to make our own mode of existence seem ridiculously simple. Allow me to give several examples.

The commonest liver fluke of man is *Clonorchis sinensis,* a species that occurs in the bile ducts in inhabitants of Japan, China, Korea, Formosa and Cochin China. The true host of this species is man or some flesh-eating animal such as the cat or dog; but before any of these final hosts can be infected the young must pass through two types of intermediate hosts. The eggs of the fluke are laid in the bile ducts of the liver down which they pass into the intestine and thence to the outside. If these eggs chance to find their way into a body of water they soon hatch into free-swimming ciliated larvae called miracidia. No further development takes place unless the miracidia are fortunate enough to encounter a snail of a certain species. When this occurs they energetically burrow their way into the tender body of the snail and grow rapidly at the expense of its soft tissues. Then a period of reproduction ensues, resulting in enormous families of young flukes called cercariae. These cercariae, however, are not yet fashioned in the image of their parents, but must first escape from their birthplace and find certain species of fish in which to spend their adolescent period. After their strenuous efforts to find one of these fish and after burrowing into its tissues they settle down to rest a while and hence form cysts. This resting period may last for a long time, but if infected fish, that is insufficiently cooked, is eaten by man the larval flukes break out of the cysts and many of them migrate into the bile ducts. Here in the bile ducts the larval flukes grow rapidly into vigorous adults and within a month are busily engaged in laying eggs so that the race may not die out. It required the labor of many scientists working over a period of many years to determine all these details, and it must have been very exciting to unravel the tangled threads of this life-cycle, since no one could possibly imagine such a wonderful series of events as these lowly worms live through before they are ready for parenthood. How many of the eggs that are laid reach water; how many of the miracidia that hatch from these eggs succeed in finding the right kind of snail; how many of the cercariae reach the appropriate fish in which to encyst; and how many of these fish are eaten raw by human beings no one knows; but it must certainly be a very small percentage of the original number. Fortunately for the parasite extraordinary powers of reproduction seem to have evolved with the parasitic habit, and enormous numbers of eggs are laid and cercariae developed. At any rate the persistence of the race proves that enough eggs are laid to prevent this lowly worm from becoming extinct amid the complexities of modern life. Well might the successful parent be proud to have overcome the many vicissitudes that beset her path at every turn, and I am sure you will agree with me that our lives seem humdrum indeed compared with that of *Clonorchis sinensis.*

The life-cycle of the malarial organism is equally wonderful, although not complicated by the intervention of *two* intermediate hosts. The malarial sporozoite that is inoculated into the blood of man by the bite of an infected mosquito must successfully avoid the white corpuscles that are always at hand to devour it, and must find a red blood corpuscle into which it can bore its way. Here it is sheltered during its growth period. Finally, however, it divides into a dozen or more daughter merozoites which break out of the blood corpuscle and must in their turn escape the white corpuscles and penetrate fresh red corpuscles. Some of those that succeed develop into sexual forms known as gametocytes. The gametocytes, however, can not continue their development in the blood of man, but perish unless they are sucked up into the stomach of certain species of mosquitoes. If they are so unfortunate as to be engorged by a culex mosquito they are promptly digested, but if the right sort of anopheline mosquito swallows them they are stimulated to further activity; eggs and spermatozoa are formed; fertilization takes place; and a worm-like creature evolves that penetrates the wall of the mosquito's stomach, where a cyst is formed. In this cyst enormous numbers of new sporozoites are produced. These in time break out into the body cavity of the mosquito, and some of them succeed in getting into its salivary glands. Here they finally perish unless their particular mosquito bites a susceptible person and they are fortunate enough to pass out into the blood stream of the new host. Any particular malarial organism obviously has small chance of fulfilling his mission in this world, but so great are the powers of reproduction of these parasites that only one in millions needs to complete

its life-cycle in order to maintain the race successfully.

The facts about *Clonorchis sinensis* and the malarial organism are well known and are accepted by most of us without realizing what a tremendous amount of labor and devotion were required to bring them to light. The history of our knowledge of malaria is of great interest not only *per se* but also as an example of how great discoveries are often brought about by the researches of hosts of first-class investigators covering a period of many years. The disease we know as malaria was recognized long before the causative agent was determined and many opinions were expressed regarding its etiology. It was by various early authorities thought to be due to meteorological conditions or to the effects of changes of temperature on the nervous system or to contaminated drinking water or to be communicated by personal contact, but it was by most people considered to be due to bad air, and many people believe even to-day that damp air is responsible for the disease. These suggestions seem rather ludicrous in the present state of our knowledge of malaria but were seriously discussed at the time they were proposed. Later, various microscopic organisms were announced as the causative agents, including unicellular algae, fungi and bacteria. In the meantime knowledge of animal parasites was increasing; flagellate protozoa (trypanosomes) were discovered in the blood serum of fishes by Valentin in 1841 and sporozoa (haemogregarines) were noted *inside* of blood corpuscles by Bütschli in 1876. So many organisms had been accused of causing malaria that when the true parasite was discovered by Laveran in 1880 its importance was not at first recognized. At this time the attention of scientists was directed toward the so-called Bacillus malariae which Klebs and Tommasi-Crudeli in 1879 claimed to have determined by experimental tests to be the causative organism, and it was not until 1885 that Laveran's findings were generally accepted. The true parasites of malaria were then found in various countries and it was not long before three species were recognized, each responsible for one type of malaria; *Plasmodium vivax* for tertian malaria, *Plasmodium falciparum* for aestivo-autumnal malaria, and *Plasmodium malariae* for quartan malaria. Life-history studies were carried on in many laboratories, but one stage escaped detection for many years and that was the most important part of the life-history, namely, the stage during which the organism is transferred from one human being to another. It was realized, however, that the missing link could easily be supplied if the method of transmission were known; hence for almost two decades some of the best scientific minds of the world were engaged in attempts to find the key to this puzzle. The fascinating story of the discovery of the method of transmission of malaria has recently been published in detail by Sir Ronald Ross in his "Memoirs" and may be cited as an excellent illustration of what can be done by scientific zeal and perseverance under extremely adverse circumstances. The story is too long to be told here, so all I can do is to state that Ross demonstrated in mosquitoes the missing stages in the life-cycle of bird malaria in 1896 and that subsequently Italian investigators proved that anopheline mosquitoes act as the transmitting agents of human malaria.

These discoveries completed our general knowledge of the life-cycle of the malaria parasites and showed us immediately the point where our attack should be directed in order to control malaria since the causative organism can not be transmitted without the presence of certain species of anopheline mosquitoes. Malaria can be prevented from spreading in any locality (1) by destroying all anopheline mosquitoes, (2) by screening infected persons so that mosquitoes when present can not bite them, (3) by screening uninfected persons so that infected mosquitoes do not have access to them and (4) by treating infected persons with quinine so that they can not transmit the organisms to mosquitoes. All these means have been employed with success in various parts of the world. The methods of controlling malaria are now well known, but each locality presents problems of its own that must be overcome before success is assured. The plan that seems to have gained the greatest confidence among public health men is to make a thorough preliminary study of each type of area it is desired to bring under control and then institute measures on a large scale.

The history of yellow fever is similar in many respects to that of malaria. During the past century yellow fever was one of the most dreaded epidemic diseases in the United States, and it is estimated that more than 500,000 cases occurred in this country from 1793 to 1900. Notable outbreaks took place in Boston in 1691 and 1693, in New York in 1668 and up to 1856, in Philadelphia in 1793 and in Baltimore in 1819. One tenth of the population died in the Philadelphia epidemic of 1793. The effect this had on the inhabitants is described by Mathew Cary as follows:

> The consternation of the people of Philadelphia at this period was carried beyond all bounds. Dismay and affright were visible in the countenance of almost every person. Of those who remained, many shut themselves in their houses and were afraid to walk the streets. . . . The corpses of the most respectable citizens, even those who did not die of the epidemic, were carried to the grave on the shafts of a chair (chaise), the horse

driven by a negro, unattended by friends or relative, and without any sort of ceremony. People hastily shifted their course at the sight of a hearse coming toward them. Many never walked on the footpath, but went into the middle of the streets to avoid being infected by passing by houses wherein people had died. Acquaintances and friends avoided each other in the streets and only signified their regard by a cold nod. The old custom of shaking hands fell into such disuse that many shrunk back with affright at even the offer of the hand. A person with a crepe, or any appearance of mourning was shunned like a viper. And many valued themselves highly on the skill and address with which they got to the windward of every person they met. Indeed, it is not probable that London, at the last stage of the plague, exhibited stronger marks of terror than were to be seen in Philadelphia from the 24th or 25th of August until pretty late in September.

New Orleans was periodically visited by yellow fever; in 1853 there were 7,848 deaths, in 1858, 4,854 deaths and in 1878, 4,046 deaths. The last large outbreak in that city appeared in 1905.

Before the causative agent of yellow fever was discovered by Noguchi in 1919 and its transmitting agent was demonstrated by Reed and his coworkers in 1900, it had been attributed to swamps, tropical temperature, atmospheric conditions, etc. The disease was brought under control because of the discovery of the transmitting agent long before its cause was ascertained. Drs. Reed, Carroll, Agramonte and Lazear were sent to Cuba to study yellow fever in 1900. Already in 1881 Dr. Carlos J. Finley had expressed the theory that yellow fever is propagated by mosquitoes, Dr. Henry R. Carter had made careful observations on the incubation period of the disease, and Ross had proved malaria to be transmitted by these insects. Hence the American investigators were able in a very short time to produce yellow fever experimentally in human volunteers by the bites of mosquitoes and thus to lay the foundation for the epochmaking campaigns carried on by General Gorgas and his colleagues in Havana and the Panama Canal Zone. These two campaigns were among the earliest and best for the control of yellow fever and malaria and illustrate two types of control work, that in Havana in a thickly populated municipality and that in Panama in a thinly populated rural district.

Efforts to eradicate yellow fever from Havana by mosquito reduction were begun in 1901 under the direction of General Gorgas at the same time as were similar efforts for the control of malaria. The average death-rate from yellow fever in Havana during the years 1853 to 1900 was 754. In 1901 the destruction of the mosquito vectors brought this number down to 18 and within a few years the entire island of Cuba was declared free from yellow fever.

Malaria control work was started in Havana in 1901. During the preceding decade (1890–1900) there was an average annual death-rate from malaria of 564 among a population of about 350,000, whereas during the next decade (1900–1910) after mosquito control measures had been inaugurated the average annual death-rate was 44, with a largely increased population. Since then malaria has been practically absent from Havana, a condition that is maintained easily and at low cost.

After his successful campaign in Cuba in 1904 General Gorgas began work as chief sanitary officer of the Panama Canal Zone. Here he found a large area covered with jungles, rivers and swamps, presenting new problems for mosquito control. These, as every one knows, were successfully solved and the canal was built. Wet areas in which mosquitoes were breeding were filled, drained or oiled; poisons were added to ponds and streams to kill mosquito larvae; the natural enemies of the mosquitoes, such as fish and dragon flies, were distributed to bodies of water where mosquitoes were breeding; and houses were screened to protect the employes from the adult mosquitoes. The results were quite gratifying. Malaria and yellow fever prevented the French from building the Panama Canal. Their losses have been estimated at fifty thousand men. Within a few years the sanitary officers of the United States had rendered these diseases a negligible factor in the Canal Zone and now one is as safe from malaria and yellow fever in the Panama Canal Zone as he is in New York City.

It is impossible in the time at my disposal to discuss even briefly all the diseases that the study of medical zoology has succeeded in practically eliminating from the world. It is only possible to cite certain interesting examples.

The Katayama disease of Japan, a disease which is known by scientists as schistosomiasis japonica, has only a local distribution in Japan; its most important endemic center being in the Katayama district near Okayama. This area contains about one hundred square miles of territory and at the height of the disease perhaps thirty thousand of its inhabitants were infected. The history of the discovery of the causative agent and its control indicates how remarkably simple the eradication of a disease may be after the life-history of the parasite causing it is fully known. Katayama disease was first described by Fujii in 1847, but it was not known to be due to the presence of the oriental blood-fluke until 1904, when the worms were found in man by Japanese investigators. During the next three years the effects of the worms on the human body were fully worked out, but the method of infection was still unknown. Contaminated drinking water was thought to be the

most probable method, but by an ingenious series of experiments Fujinami and Namakura in 1909 proved that the parasites gained entrance to the body through the skin. Many Japanese investigators were by this time profoundly interested in this problem and by the end of the next four years the entire life-history of the organism had been worked out, especially by Miyairi and Suzuki, a life-history similar in many ways to that of *Clonorchis sinensis*. The eggs that are passed in the feces hatch in the water, giving rise to ciliated miracidia. These swim about until they come in contact with a certain species of snail into which they bore their way. Within the snail they undergo rapid multiplication, finally emerging in a form resembling a minute fork-tailed tadpole. These little organisms then lie in wait for any animal they may chance to come in contact with, whereupon they penetrate the skin, make their way into the blood stream and finally reach the liver, where they grow into adult worms. The solution of the purely zoological problem of the life-history of this worm accomplished for the Katayama disease what the elucidation of the transmission of the malarial organisms by mosquitoes did for malaria—it furnished a means of attacking the intermediate host. This was immediately begun and it was soon discovered that the addition of lime to the water resulted in the death of the snails and without the snails the worms could not complete their life-cycle successfully and were hence destroyed. Between the years 1913 to 1923 the Katayama disease was practically eradicated from its original home by the elimination of the intermediate host, the snail.

The knowledge gained by the study of the oriental blood-fluke by the Japanese immediately enabled other investigators to solve the problems presented by blood-flukes in other parts of the world. All that needed to be done was to determine the species of snail that acted as intermediate host and by destroying these snails prevent the production of the infective stages of the parasite. This method will probably in time bring about the eradication of all human blood-flukes.

Another disease whose conquest may be placed to the credit of medical zoology is bubonic plague. Epidemics of this disease have occurred from time to time in various parts of the world. In the 14th century one fourth of the population of Europe died of plague, and a similar catastrophe might have overtaken the United States when this disease was introduced into San Francisco in 1900 if we had not known how to control it. The plague germ was discovered by Yerson in 1894 and found to be the same as that occurring in rats. In 1905 Liston noted the growth and multiplication of these germs in rat fleas, and in the following year the British Plague Commission in India proved the rat flea to be the principal transmitting agent. Epidemics of plague can now be prevented by destroying rats and rat fleas. This was done by the U. S. Public Health Service in the San Francisco epidemic; over a million rats were caught, examined and destroyed. Unfortunately the ground squirrels in certain parts of California became infected and over twenty million of them were killed also before the disease was considered under control. As a result of these efforts only 187 cases of plague in man occurred in the California epidemic. Within the past month plague has again broken out in California, but our knowledge of the transmission of the disease will undoubtedly make it possible to prevent its spread and thus save the lives of thousands of persons.

Other insects besides the flea that serve as vectors of human diseases are phlebotomus flies that carry three-day fever and are suspected of transmitting Verruga Peruviana and cutaneous leishmaniasis; culicine mosquitoes that carry filariasis as well as yellow fever and dengue; tsetse flies that are the vectors of sleeping sickness; house flies that distribute the germs of typhoid fever and similar diseases; assassin bugs that carry Chagas fever in South America; and lice which have been proved to be vectors of relapsing fever, typhus fever and trench fever. Nearly related to these insects are the ticks which carry relapsing fever and Rocky Mountain spotted fever.

The most recent and in many ways the most remarkable conquest of disease due to parasitic organisms presents an example of a house divided against itself, since one parasite is engaged to combat another parasite. The disease called general paralysis, paresis or softening of the brain has been known and dreaded for centuries. It is the result of infection with the syphilitic organism, *Treponema pallidum,* and is a form of insanity characterized by the gradual loss of the mental faculties, followed by dementia, death taking place usually in from a few months to five or six years. Wagner von Jauregg, of Vienna, discovered in 1920 that malarial organisms, when inoculated into patients suffering from general paralysis, brought about a distinct improvement in the course of this disease. Patients were allowed to go through eight or nine malarial paroxysms; were then treated with quinine to check the malaria; and were finally given six injections of neosalvarsan, which is a specific therapeutic agent for syphilis. Von Jauregg reported 120 completed cases. Of these, 30 were discharged from the hospital as cured and 51 were greatly improved but not entirely cured. What the mechanism of these cures is is not known, but the

theory is that malarial immune bodies are produced which activate the protective powers of the body against paresis.

These investigations naturally stimulated similar studies in other parts of the world, the results of which are now appearing in scientific periodicals. Among these is a recent report by Yorke and Macfie, of the Liverpool School of Tropical Medicine. Eighty-four patients suffering from general paralysis were studied by these investigators, and sufficient time has elapsed since their experiments were begun to furnish definite results. The physical and mental condition of 23 of these patients improved so much that they were discharged from the hospitals; great physical and distinct mental improvement was observed in 17 of the patients; a physical gain but no mental progress was noted in 10 cases; and although no noticeable change was evident in 20 of the patients, many of these would have died if they had not been infected with malaria. The fact also should be emphasized that no patient suffering from general paralysis had ever previously been discharged from the hospitals in which Drs. Yorke and Macfie carried on their experiments. Here then is the malarial organism, which causes one of the most important diseases of man, being employed to cure another and even more dreadful parasitic disease.

It is interesting to note the rapid progress that has been made in the control of diseases due to animal parasites throughout the world, and it is gratifying to us to realize that an American institution is the foremost leader in this movement. I refer to the Rockefeller Foundation. This foundation grew out of the discovery by medical zoologists that much of the shiftlessness and misery among certain classes of people in our southern states was due to hookworm disease. The clinical symptoms of hookworm disease, including dirt-eating, laziness and anemia, were described from Louisiana as early as 1821, and fragmentary reports of the finding of the worms themselves were recorded at intervals beginning about 1864; but serious attention was not directed to the disease until Dr. C. W. Stiles, of the Hygienic Laboratory of the United States Public Health Service, began a series of studies which culminated in the organization of the Rockefeller Sanitary Commission in 1909. The control of hookworm disease is a relatively simple matter, but Dr. Stiles and the commission were subjected at first to much ridicule, which, however, gave way to praise as soon as the quick and revolutionary results of their work began to appear. Great progress was made during the four years this commission was in existence. At the end of this time (1913), the Rockefeller Foundation was established, with an initial endowment of $100,000,000, for the purpose of promoting "the well-being of mankind throughout the world," and one of the first acts of this foundation was the reorganization of the Rockefeller Sanitary Commission as the International Health Board. Among the principal objects pursued by this board have been the control of hookworm disease, malaria and yellow fever. Nearly $4,000,000 were spent from 1913 to 1923 for the relief and control of hookworm disease, over $1,000,000 for yellow-fever control and almost $800,000 for malaria control. The indirect results of this work have probably been no less important than the direct decrease in the incidence of these diseases in the areas covered, since permanent public health activities of various sorts, supported entirely by the people concerned, have grown out of these campaigns for the control of diseases due to animal parasites.

Much of this work has been done in tropical and semi-tropical countries largely because diseases due to animal parasites increase in number and variety as one approaches the equator—a condition resulting from a combination of favorable factors. Transmission from one host to another is easier in the tropics than in the north, where the infective stages of the organism are often subjected to freezing temperatures; sanitary conditions are usually less rigid in the tropics, thus facilitating the spread of disease, and the transmitting agents, such as mosquitoes, are active almost continuously throughout the year. In the north many diseases of animal origin have almost entirely disappeared because the breeding places of the transmitting agents have been eliminated by intensive cultivation of the soil; and pollution of the soil is prevented by modern plumbing. Residents of rural districts in the north, where sanitary measures are not as strictly enforced as in the cities, are more frequently infected than those of the cities, but even in the latter there is a surprisingly high incidence of infection with certain animal parasites. For example, Dr. G. C. Payne and I compiled data contained in the literature for about twenty thousand cases which had been examined for intestinal protozoa, and found that 20 per cent. were infected with *Endamoeba coli*, 12 per cent. with *Giardia lamblia*, 9 per cent. with *Endamoeba hystolytica*, 4 per cent. with *Chilomastix mesnili* and 3 per cent. with *Trichomonas hominis*. I have no doubt but that this average would be found to hold among the members of my present audience. Fortunately these organisms are not usually pathogenic.

Facilities for rapid transit have made of public health a world problem. Disease-producing organisms may be transported from one locality to another and for long distances either by human carriers or by the intermediate hosts. A human carrier is a

person who is infected and thus carries the parasites from place to place on or within his body but who does not exhibit symptoms of disease. Carriers more or less unconsciously distribute the infective organisms and are responsible for spreading infectious diseases among susceptible persons. The intermediate hosts of animal parasites are usually lower animals, such as cattle, dogs, snails and insects; these are also frequently transported from one country to another. It has not always been necessary, however, to take drastic action for the purpose of preventing the importation of animal parasitic diseases into the United States because of their complicated life-histories. Malaria can not be transmitted in a locality where certain species of anopheline mosquitoes are absent, even if persons with malarial parasites in their blood are present in large numbers. The Katayama disease of Japan can not gain a foothold in this country, even though many infected Japanese are allowed to enter, because the species of snail which acts as the intermediate host of the oriental blood fluke does not exist in the United States. The habits of the general population have a considerable influence on the spread of parasitic diseases. For example, the lung fluke, *Paragonimus westermani,* which is also a common parasite in Japan, depends for its transmission upon the peculiar habit of certain orientals of eating certain fresh water crabs raw in which are the encysted stages of the fluke all ready to start a new infection in any one who swallows them. We in the United States are safe from this parasite because we do not eat raw crabs. We, however, place ourselves in danger whenever we visit foreign countries, particularly in the tropics. One must be careful when in certain parts of China, Japan and Egypt to avoid water for bathing purposes that may contain the infective stage of the blood fluke. It is necessary also to see that all uncooked vegetables are thoroughly cleansed in order to escape ingesting hookworm larvae and cysts of the dysentery amoeba and of intestinal flagellates. More precautions must also be taken to avoid being bitten by mosquitoes that may transmit malaria, yellow fever, dengue and other diseases.

It is evident that one field in which medical zoology has taken the leading rôle is that of rendering the tropics as habitable for man as are the temperate regions of the earth. I have already described the conquest of malaria and yellow fever and shown how Havana, Cuba and the Panama Canal Zone were transformed into healthful districts by putting into operation simple control measures perfected from the results of scientific investigations. All this has a distinct bearing upon one of the greatest problems before mankind at the present time—the problem of population. Statistics show that the world's population has increased about two and one half times during the past century. Population is continuing to grow and millions of acres of new lands must each year be made productive in order to keep mankind from hunger and starvation. Many methods of preventing further increases in population have been suggested and no one can predict what the future may have in store for us in this direction. We must, however, face the problem that confronts us to-day, and this problem involves the opening up of new land every year. In tropical America and in other tropical countries large areas of fertile country exist that are now unproductive. That these tropical regions can be made healthful to men from the colder regions of the earth has been proved again and again by various nations that have founded colonies in the torrid zone. To do this it has only been necessary to control certain diseases, and these diseases have been for the most part due to animal parasites or their transmitting agents.

During the past summer I obtained a first-hand knowledge of conditions in tropical America, having visited plantations and hospitals in Cuba, Jamaica, Guatemala, Honduras, Costa Rica, Panama and Colombia. The number of deaths and extent of the sickness and misery due to diseases of animal parasitic origin was quite startling. In fact the principal difference between the diseases of the American tropics and those of the northern United States is the prevalence in the former of maladies due to infections with animal parasites. Statistics gathered together by the doctors in the nine divisions of the United Fruit Company show that malaria alone was responsible in 1923 for 38 per cent. of 27,654 cases treated in their hospitals, and that 205 of every thousand employees were admitted to their hospitals with malaria and that ten of every thousand deaths were due to this disease. Hookworm disease is more insidious than malaria; it does not bring about sudden prostration but slowly saps the vitality of its victims; hence, although it is probably as widespread, hospital admissions due to its ravages are not so frequent; nevertheless 5 per cent. of the hospital cases were suffering from this disease. A third cause of sickness and death is amoebic dysentery. In 1923, 420 cases of amoebic dysentery were treated in the hospitals of the United Fruit Company, and a large proportion of these patients failed to recover, principally because the disease was in an advanced stage when treatment was begun. Not infrequently natives are encountered in tropical America who are veritable museums of medical zoology. Many of them are chronically infected with from one to three species of malarial parasites, with two or more species of

intestinal amoebas, with several species of intestinal flagellates, with hookworms and from two to four other species of worms, and externally with several species of parasitic insects. Undoubtedly the tropics offer a happy hunting ground for medical zoologists as well as for public health workers. Here are vast areas that may be made habitable by the introduction of control measures that have already been perfected and are very simply put into operation.

Before concluding my lecture I should like to say a few words about where work in the field of medical zoology is being done. In the first place, much of the subject known as tropical medicine is devoted to the study of diseases due to animal parasites, hence we find medical zoology the most important subject in schools of tropical medicine such as those at London, Liverpool, Brussels, Amsterdam and Hamburg. In this country investigators in the field of medical zoology are working in the U. S. Public Health Service, the U. S. Department of Agriculture, in various institutions, such as the Rockefeller Institute, and in colleges and universities. Physicians, especially those living in tropical or semi-tropical countries, are also continually adding to our knowledge of animal parasites and human disease.

The successful control of such diseases as malaria, yellow fever, hookworm disease, plague, Katayama disease and many others is very gratifying to medical zoologists, since millions of human beings have thus been saved from suffering and death. But there are still many diseases that are only partly under control and about which very little is known. Even malaria, which has been studied for many years by some of the best of our scientists, still offers many problems for solution. It sometimes seems that we will never know all there is to be learned about any one of these diseases, but as Pasteur, who was at least in part a medical zoologist, remarked, "To travel hopefully is a better thing than to arrive, and the true success is to labor."

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THE RUMFORD FUND

THE following is a brief history of the Rumford Fund, as well as of the purposes for which it was created and has been maintained.

Benjamin Thompson was born at Woburn, Mass., in 1753, and studied at Harvard College, being much interested in scientific subjects. He was a teacher in schools at Wilmington, Mass., and at Rumford, N. H. He went to England in March, 1776, and carried on there a series of scientific studies, the results of which were communicated to the Royal Society. He was elected a fellow of that society in 1779.

In 1785, he entered the service of Prince Maximilian, the Elector of Bavaria. He introduced a number of important reforms into that country, while also carrying on an important series of scientific researches. One result of these researches was a demonstration of the equivalence between heat and mechanical work. He reclaimed a large area of barren land at Munich, and formed it into a fine park, which he subsequently gave to the city and which is still known as the "English Garden." In 1791, he was invested with the rank of a Count of the Holy Roman Empire, and chose the title of Rumford, the New Hampshire village in which he had taught as a youth, and in which the family of his wife had resided.

In 1802, he removed to Paris, where he met and married his second wife, who was the widow of the celebrated chemist, Lavoisier. It was in 1794 that the French revolutionary government had sentenced Lavoisier to death under the guillotine, at what is now the Place de la Concorde in Paris.

Count Rumford founded the Rumford Research Medals of the Royal Society in London and of the American Academy of Arts and Sciences in Boston. He also founded a Rumford professorship in science at Harvard University. During his life, he made numerous contributions to economics, physics, meteorology and chemistry. He died at Auteuil, Paris, in 1814.

The American Academy of Arts and Sciences has continued to administer the Rumford Fund, by awarding premiums and grants, in aid of researches in light and heat. The academy maintains a standing committee of seven fellows, known as the Rumford Committee. This committee, from time to time, recommends to the academy the award of the Rumford premium or medal to persons in North America or any of the American islands, who have notably contributed to the sciences of heat or light. The committee also considers all applications for grants from the income of the fund in aid of research connected with those sciences.

Since 1839, the academy has made thirty-two awards of the Rumford premium to scientific investigators. It has also made nearly 250 grants of money to researchers, varying in amount between $25 and $750, but averaging about $260 each. These grants are for apparatus, materials or experimental equipment. They are also made towards costs of printing in the publication of researches. Only in very rare cases have grants been made towards the payment of assistants in carrying on such researches.

The subjects of research aided by the Rumford Fund are light and heat. More recently, the subject of X-rays has been accepted as coming within the scope of the fund.

Recipients of grants for investigations are ex-

pected to report annually to the committee as to the progress of the work for which the grant was made.

Researches carried on with aid from the Rumford Fund may be published in any place or form, with the proviso that due recognition be made of the grant as from the Rumford Fund of the American Academy of Arts and Sciences. It is expected that a complete copy of every such publication shall be presented to the academy.

Persons making application for grants from the Rumford Fund are expected to inform the committee of any similar applications made by them for grants from other funds in aid of the same research, or of related researches.

Applications for grants should be addressed to the Chairman of the Rumford Committee, Care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston. Such an application may be made by any duly qualified person in North America or in any of the American islands. It should specify the nature of the research and the particular aid desired.

A. E. Kennelly,
Chairman of the Rumford Committee

EDMUND OTIS HOVEY (1862–1924)

The unexpected death of Dr. Edmund Otis Hovey, for many years curator of geology of the American Museum of Natural History, New York City, came as a severe shock to the geologists of America. For a generation he had been a familiar figure in the councils of the leading organizations fostered by investigators in the science of geology, and his service in them has left an impress that will last for many years. Few men had a greater number of personal friends in his own field or a wider acquaintance in his science the world over. His passing has given a distinct sense of personal loss to a host of people, far beyond the bounds of intimate family ties and friend-associates. It is well to stop and pay tribute to the memory of such a man.

Edmund Otis Hovey was born of New England parents, in New Haven, Connecticut, September 15, 1862. After a career of great usefulness and activity, which continued unto the very day of his death on September 27, 1924, his life work came to a sudden end in the midst of a busy day, almost as any very active man might wish.

By inheritance, training and subsequent opportunity, Dr. Hovey was marked for geological service, and few men in the field of geology in America have filled their niche better. His father, Horace Carter Hovey, before him, was deeply interested in geologic phenomena, but was a minister of the gospel by profession, a calling which he followed all his days. The scholarly atmosphere of the parsonage, coupled with a deep love of scientific investigation, furnished a favorable environment.

To this helpful environment of youth and to his native talent were later to be added a training that could not readily be surpassed and an opportunity far superior to that vouchsafed to most men of scientific bent. It is true that his preparatory education was somewhat broken by the many moves of the family to different places in the Middle West and in New England, but the cities and towns to which his father was called to preach were among the better places of those days. Even this experience was but a foretaste of travels to many distant lands that it became his own lot to visit and study in later years.

He attended Yale College in the days of the elder Dana, one of the great masters of earth science in America and it was in such surroundings that he began to formulate plans for a scientific career. After finishing his college course he was for two years a teacher and principal in the schools of Minnesota; but was not content to follow that call, and in 1886 he returned to Yale for graduate study in geology and mineralogy, securing the degree of doctor of philosophy in 1889. Additional years of teaching and school administration were followed by travel and study abroad, where he came in touch with some of the most famous scientists of Europe, notably with Professor Rosenbusch, the most eminent petrographer of his day, whose influence seems to have followed him the rest of his life. From that time he devoted himself to scientific work in his chosen field, to the organizing of geologic data for educational purposes and ultimately to very distinguished service as an editor and as the chief responsible officer of one of the greatest scientific societies.

The first step was taken in 1893 when he was placed in charge of the Missouri State exhibit of minerals at the Columbian Exposition in Chicago. The ability displayed in that engagement attracted the attention of museum directors; and at the invitation of the American Museum of Natural History, New York City, he accepted a position on the geological staff of that institution, where he served the rest of his life. It was neither luck nor favor, but a perfectly natural outcome for a man who had already proved his mettle and had made good on the first opportunity presented.

His years at the American Museum carried him through all grades and many kinds of service to a curatorship in charge of the department of geology, one of the highest scientific responsibilities in that organization, which post he held for fourteen years. In the course of his service at the museum an enormous amount of work had to be done in making the immense collections of that institution of greatest usefulness both to scientists, who look to it for com-

parative material and to the general public, who look to it for guidance and instruction.

His skill in the organizing of material for the latter purpose never forsook him, and he was engaged on undertakings of this kind to the last day of his life. The writer of this memorial note was in consultation with him several times within the last month, working carefully over an exhibit of the geology of New York City; and at the time he was stricken, Dr. Hovey was about to start on a field trip to gather additional information for a similar purpose. While it is always difficult to measure the value of service of this kind, it is not at all difficult to see the effect it has if one will but watch the endless procession of visitors who pass through the corridors of the museum.

Dr. Hovey was instrumental in establishing *The American Museum Journal,* the forerunner of *Natural History,* and for ten years he was its editor. At the same time he was secretary of the New York Academy of Sciences and editor of its "Proceedings" and "Annals." In 1907 he was elected secretary of the Geological Society of America, and thereby became the most influential member and the chief executive officer of that important organization. For sixteen years he held this post and discharged its arduous duties with marked success. The demands of these several organizations finally became so exacting that he found it advisable to retire from them all to give undivided attention to his museum duties and to his unfinished researches. He proposed to devote the rest of his life to publishing the results of years of exploratory experience, much of which, in the press of these other duties, had been crowded into the background.

In spite of his many official duties, however, he had managed to write more than one hundred and fifty scientific papers, covering a great variety of subjects within his chosen field and representing field studies that touched many foreign countries. He was an authority on volcanic phenomena. Through his two years of enforced stay in the Arctic he had opportunity to make observations along the Greenland border, and in his very last year he visited Australia as the guest of the Third Pan-American Scientific Congress, on special invitation of the geologists of Australia. One of his best-known contributions was his study of Mt. Pelé in Martinique, which he visited immediately after its eruption and twice thereafter.

Dr. Hovey was twice married. His first wife, Miss Esther A. Lancraft, who died in 1914, was an active helper during her lifetime in his many interests. In 1919 he married Miss Dell G. Rogers, who, with a young daughter, Constance, survives him.

Dr. Hovey had unusual fitness for the type of service that he was called on to render to the science of geology. As secretary of the Geological Society of America he came into close relations with all the leading geologists of the United States and could count them as his personal friends. As head of the department of geology of the American Museum of Natural History and organizer of its impressive exhibits he touched the millions of visitors who pass through that institution. It is difficult to fathom the extent of his influence—so much of it went into the building of a better educational science service rather than to more tangible product. In this field he was a very distinguished man and every geologist in America feels the shock of his death. It is difficult to realize that the wise counsellor of more than a generation has passed away.

CHARLES P. BERKEY

COLUMBIA UNIVERSITY

SCIENTIFIC EVENTS

RESOLUTION OF THE INDIANA ACADEMY OF SCIENCE

AT the annual meeting of the Indiana Academy of Science held at Purdue University, LaFayette, Indiana, December 4 and 5, the following resolution was passed with the request that it be sent to SCIENCE for publication:

WHEREAS, In reviewing the literature on various biological subjects, members of the Indiana Academy of Science have noted the following bad practices on the part of various authors and publications:

(1) That in giving bibliographic references some authors cite merely the volume and the page of the publications, but omit the date;

(2) That authors do not fully index all species and synonyms mentioned in their work, but are often content to index merely the valid genera as they see them;

(3) That reviews and scientific articles are often signed with the initials and not the name of the author so that the bibliographer is often at a loss to know who the author is;

(4) That the date of publication of some of the prominent scientific serials is printed on the cover page instead of on a numbered page of the issue, which makes necessary the binding of said cover and the advertisements;

Therefore, Be it resolved by the Indiana Academy of Science at its fortieth annual meeting that such practices as have been enumerated above be heartily disapproved and that the following suggestions for the benefit of all scientific workers are hereby approved:

(1) That all authors give the volume, page and date of publication when referring to publications;

(2) That all authors index fully all species, genera and synonyms mentioned in their work;

(3) That the full name of the reviewer or author be signed to all reviews or scientific articles;

(4) That all scientific publications print the date of publication on a numbered page either at the beginning or the end of the scientific matter so that the binding in of the cover and advertisements will not be necessary.

NEW GIFTS TO EDUCATION

FORTY-SIX million dollars have been given to the creation of a trust fund by James B. Duke to be used for educational, charitable and religious purposes, chiefly in the states of North and South Carolina.

Announcement of the fund, to be administered by fifteen trustees as a self-perpetuating body, was made by Mr. Duke, who in specifying the institutions and purposes for which the fund will be used, said the securities set aside for it include about three fourths of his holdings in the Southern Power System.

The fund contains an alternative provision by which Trinity College at Durham, N. C., may have $6,000,000 of the total to be used in its expansion if it elects to change its name to Duke University. Otherwise, the trustees are directed to spend not more than that amount in establishing a Duke University in North Carolina.

Providing for retention of twenty per cent. of the annual income on the remaining $40,000,000 to be added to the principal until it amounts to $80,000,000 the plan specifies the division to be made of the remaining income, with 32 per cent. to go to Duke University for "all purposes" and an equal percentage to the building and maintenance of hospitals, chiefly in North and South Carolina. Smaller percentages are alloted to charitable work among whites and negroes in the two states, to the Methodist Episcopal Church in North Carolina and to other educational institutions in the two states.

Bringing his total known benefactions to $58,602,900, George Eastman, head of the Eastman Kodak Company, has announced new gifts of $12,500,000 to institutions of higher education, after recently announcing a gift of $2,500,000 in the greater University of Rochester campaign. Those to benefit under the latest gifts of Mr. Eastman are: Massachusetts Institute of Technology, $4,500,000, which is added to a previous gift of $11,000,000; University of Rochester, $6,000,000; Hampton Institute, $1,000,000, and Tuskegee Institute, $1,000,000.

Of Mr. Eastman's total of $58,602,900, the sum of $23,578,500 has been given to the University of Rochester, making this institution the largest single recipient of his gifts.

Gifts just made and not announced before are under terms similar to those made to employees. Stock is sold to benefiting institutions for $12,500,000 less than its actual value. While provision is made that it may be paid for in installments during the life of Mr. Eastman, it is given without any restriction regarding the time for sale. It may be sold at once if the beneficiaries desire to part with it.

PLANS FOR THE NEW YORK BOTANICAL GARDEN

EXPENDITURE of approximately $7,000,000 to make the New York Botanical Garden a model for the world is contemplated by the Board of Managers, whose plans have been announced by the president of the board, Dr. Frederic S. Lee, 437 West Fifty-ninth Street, research professor of physiology at Columbia University. The announcement explains that "endowment, equipment, maintenance and research are among the purposes to be advanced," and then says:

The realization of the requirements for adequate maintenance, needed improvements and desired advance would place the New York Botanical Garden in a position of leadership in this country, if not in other countries, in matters that deal with plants in their various scientific, esthetic and economic relations to man.

The garden would then stand conspicuous among the best of the public institutions of the city. To enable it to assume this rightful position its funds must be largely increased, and chiefly by private beneficence.

The actual amount of money required would be approximately $7,000,000, in the form partly of moneys to be directly expended, and partly of increased endowment. The more urgent needs demand the sum of $4,000,000, of which $800,000 should be expended for material improvements and equipment and the remainder be added to the endowment.

The Board of Managers is making an effort to obtain this needed $4,000,000, and confidently looks to the people of New York to contribute it.

PROGRAM ON THE HISTORY OF SCIENCE AT WASHINGTON

THERE will be a joint meeting of Section L, of the American Association for the Advancement of Science, and the History of Science Society at Washington on December 31 and January 1, at which the following program will be presented:

WEDNESDAY, DECEMBER 31, 1924, AT 2 P. M.
Room 24, Corcoran Hall, George Washington University
DR. L. J. HENDERSON,
of Harvard University, presiding

Development of the present day conception of palaeontological history: DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington.

Arabic science in Christian Europe: DR. CHARLES H. HASKINS, professor of history, Harvard University.

Study of medieval science: DR. GEORGE SARTON, research associate, Carnegie Institution of Washington and lecturer of the History of Science, Harvard University.

The life and work of Dr. William A. Locy (the first chairman and vice-president of Section L [History of

Science], *A. A. A. S.*): Dr. C. E. Tharaldsen, professor of zoology, Northwestern University.

Council meeting of the History of Science Society, Cosmos Club, 7 o'clock P. M.

Thursday, January 1, 1925, at 2 P. M.
Room 24, Corcoran Hall, George Washington University
Dr. L. C. Karpinski,
of the University of Michigan, presiding

Leibnitz, the master builder of mathematical notations: Dr. Florian Cajori, professor of history of mathematics, University of California.

Benjamin Peirce: Dr. R. C. Archibald, professor of mathematics, Brown University.

The natural sciences in the University of Paris during the Middle Ages: Dr. L. J. Paetow, professor of history, University of California.

The study of western science of the fourteenth and fifteenth centuries: Dr. Lynn Thorndike, professor of history, Columbia University.

Frederick E. Brasch,
Secretary of Section L (History of Science), A. A. A. S., Assistant Secretary of the History of Science Society

SCIENTIFIC NOTES AND NEWS

Dr. David Starr Jordan, chancellor emeritus of Leland Stanford University, has been awarded the prize of $25,000 offered by Raphael Herman, of Washington, for the best educational plan calculated to maintain world peace.

At a meeting of the Royal Society, London, on December 1, it was announced that a third research professorship has been provided from the munificent gift from their fellow, Sir Alfred Yarrow. To this professorship, Professor O. W. Richardson, noted for his work in relation to the emission of electrons from hot bodies, has been appointed.

At a meeting of the Royal Society, London, on December 1, the following officers and members of council were elected: *President,* Sir Charles Sherrington; *treasurer,* Sir David Prain; *secretaries,* Mr. W. B. Hardy and Mr. J. H. Jeans; *foreign secretary,* Sir Richard Glazebrook; *other members of the council,* Sir Frederick Andrewes, Professor J. H. Ashworth, Dr. F. W. Aston, Sir William Bragg, Professor S. Chapman, Sir Dugald Clerk, Dr. H. H. Dale, Professor F. G. Donnan, Professor A. S. Eddington, Professor E. S. Goodrich, Sir Thomas Holland, Professor J. B. Leathes, Professor T. R. Merton, Dr. G. C. Simpson, Professor J. F. Thorpe and Professor F. E. Weiss.

Emile Picard, professor of mathematics at the University of Paris and secretary of the Academy of Sciences, has been elected to membership in the French Academy in the place of Charles de Freycinet.

Dr. Roksabro Kudo, of the department of zoology of the University of Illinois, had conferred upon him the degree of *Rigaku-hakushi* (D.Sc.) by the department of education of the Nihonese government, through the Tokio Imperial University, in recognition of his work in protozoology.

At the meeting of the French Academy of Medicine on November 4, Professor Vallée, director of the research laboratories of the University of Agriculture, was elected a member.

At a recent convocation at Whitman College, the members of the Alumni Association who had taken their major work in biology arranged a special program in recognition of the twenty-five years of service to the college of Professor H. S. Brode. The recognition included the presentation of a gift as well as words of appreciation.

On the occasion of the completion on October 1 of twenty-five years of service to Teachers College, Columbia University, of Dr. Maurice A. Bigelow, professor of biology at Teachers College and director of the School of Practical Arts, a group of his colleagues met at his office, and Dr. Benjamin R. Andrews, associate professor of household economics, spoke in appreciation of Dr. Bigelow's work for the college.

Dr. Charles P. Emerson, dean of the Indiana University School of Medicine, Indianapolis, has been elected president of the National Committee for Mental Hygiene, to succeed Dr. William H. Welch, director of the School of Hygiene, of the Johns Hopkins University.

Vacancies on the board of trustees of the Carnegie Institution, caused by the resignation of Cleveland H. Dodge and the deaths of William L. Hutchinson, Senator Henry Cabot Lodge and Robert S. Woodward, were filled by the elections of Secretary Mellon, Speaker Gillett, of the House, William Benson Storey, of Chicago, and Cass Gilbert, of New York City. The resignations of Charles P. Fenner and Henry P. Walcott were received and these vacancies will be filled next year.

Director Paul M. Lincoln, of the School of Electrical Engineering, of Cornell University, was called to Philadelphia on November 25 to attend the first meeting of the program committee for the International Engineering Congress, to be held in that city in 1926.

At the annual meeting of the New York Academy of Medicine officers were elected for the coming year as follows: *President,* Dr. Samuel A. Brown; *Vice-*

president, Dr. Frederick T. Van Buren, Jr.; *Trustee,* Dr. George D. Stewart; *Recording Secretary,* Dr. Fenwick Beekman.

At the October meeting of the French Academy of Sciences, M. Deslandres, director of the Astronomical Observatory of Meudon, was elected a member of the scientific section of the National Meteorological Office, to take the place of the late Professor J. Violle.

Dr. Alfred E. Cohn, of the Rockefeller Institute for Medical Research, who has accepted a three months' appointment as visiting professor of medicine at the Peking Union Medical College, China, sailed for Europe on December 17. He will proceed to China by way of Suez, arriving about April 1.

According to the *Journal* of the American Medical Association, Dr. G. Dumas was the first exchange professor reaching Mexico since the foundation of the university exchange between France and Mexico. The arrangement is that two French professors are to lecture in Mexico in July, August and September. An honorary degree was conferred on Dr. Dumas, and he was elected an honorary member of the Mexican Academy of Medicine.

Dr. George B. Cressey, assistant professor of geology in Shanghai College, has returned to Shanghai after extended geological reconnaissance in Kansu, Mongolia and Tibet. During a four-month trip from Peking, physiographic and structural studies were carried on in the Ordos and Alashan Deserts and around Lake Koko Nor.

Dr. L. S. Fridericia, professor of hygiene in the faculty of medicine of the University of Copenhagen and an official adviser of the State Board of Health, Denmark, one of a group of five Scandinavian health officials who have been making a study of public health administration in the United States under the auspices of the International Health Board of the Rockefeller Foundation, sailed for France on December 3. Two other members of the group, Dr. H. M. Gram, chief medical officer of the Health Department of Norway, and Dr. Andreas Diesen, assistant director of the Health Department of Christiania, left on December 9.

Miss Beatrice Monk, matron of the London Hospital, an institution having the largest training school for nurses in England, has spent the past five weeks in the United States and Canada as the guest of the Rockefeller Foundation, for the purpose of visiting hospitals and nurse training schools. Miss Monk returned to England on December 13.

The announcement cabled from Paris of the death of Professor Bergonié, the French radiologist, is incorrect. He is seriously ill from burns received in the early days of X-ray experimentation. He has presented to the Bordeaux Faculty of Medicine the sum of 100,000 francs for the construction and installation of an institute in connection with the cancer campaign. M. Bergonié has been raised to the rank of the Grand Cross of the Legion of Honor by the French government.

Professor W. M. Davis will spend the winter in California where he will lecture on geographical problems at the University of California, both at Berkeley and at the Southern Branch in Los Angeles, at the museum in San Diego, at the Scripps Institute at La Jolla and at Stanford University. During his westward journey he gave lectures at the Southern Methodist University in Dallas, at Rice Institute in Texas, and the University of Arizona.

Dr. W. Lee Lewis, director of the department of scientific research of the Institute of American Meat Packers, recently lectured before the local sections of the American Chemical Society at Rochester, Akron, Columbus, St. Louis and Kansas City, on the subject of "The professor in the packing industry." Dr. Lewis is on a leave of absence from Northwestern University for the purpose of organizing the department of scientific research of the Institute of American Meat Packers.

On November 29, Dr. Frederick K. Morris, geologist of the third Asiatic Expedition of the American Museum of Natural History, delivered an address before the Royal Canadian Institute on "Central Asia as the birthplace of man."

Dr. Lauge Koch, explorer and geologist, of Copenhagen, Denmark, addressed the department of geology of the University of Chicago, on November 20, on "New features of the physiography and geology of Greenland."

Dr. William H. Howell, professor of physiology and assistant director of the school of Hygiene and Public Health of the Johns Hopkins University, addressed the Institute of Medicine of Chicago on November 28 on "Problems in blood coagulation."

Dr. Leo H. Baekeland, president of the American Chemical Society, gave an address before the members of the Pittsburgh section of the society on November 21, dealing with the subject of "Misdirected energy" and reviewing briefly the history of the rise of the chemical profession.

Colonel E. B. Vedder, of Edgewood Arsenal, delivered an address on "The toxicity of lead tetraethyl and other substances" at a joint meeting of the Washington Academy of Sciences, the Baltimore Section of the American Chemical Society, the Chemical Society of Washington and the Medical Society of the Dis-

trict of Columbia, in the Cosmos Club, Washington, December 11, 1924.

THE annual dinner of the New York Academy of Sciences and its affiliated societies was held at the Waldorf-Astoria Hotel on December 15, when Dr. Clyde Fisher gave an address entitled "Across the trail of Linnaeus in Arctic Lapland."

DR. LAUDER JONES, of Princeton University, gave an address before the members of the Delaware section of the American Chemical Society, Wilmington, on November 19, on the subject "The rôle of nitrogen in inorganic and organic molecules."

DR. AXEL REYN, director of the Finsen Light Institute, Copenhagen, Denmark, recently gave a lecture at the University of Buffalo on "Light therapy."

A LARGE bronze tablet, designed by the Boston sculptor Bashka Paeff, and set in the wall in the reception room, Boston Psychopathic Hospital, in memory of Dr. Elmer Ernest Southard, was unveiled with appropriate ceremonies on November 18. Dr. Southard, formerly professor of psychiatry and neurology at Harvard University, who died in 1920, was the founder of the Boston Psychopathic Hospital and its first director.

STEPS have been taken to place a bronze *bas-relief* of the late Mrs. Ellen H. Richards, with suitable inscription, in an appropriate location in one of the buildings of the Massachusetts Institute of Technology.

THE fund which is being raised at the University of Leeds to commemorate the services of Professor A. Smithells has now reached a total of nearly £2,500. A portrait of Professor Smithells has been painted by Mr. Fiddes Watt and the presentation ceremony took place on November 25. The balance of the fund will provide a scholarship, of approximately £100 per annum, which is to be established in the university in the name and with the advice of Professor Smithells.

DR. EZRA BRAINARD, who was for twenty-five years president of Middlebury College, and earlier professor of physics, known for his contributions on the geology of the Champlain Valley and the botany of Vermont, died on December 8, aged eighty years.

DR. E. W. STANTON, formerly professor of mathematics at Iowa State College, recently died, aged seventy-four years.

DR. JOHN IRVINE HUNTER, professor of anatomy at the University of Sydney, Australia, who has been invited to give the Murphy oration at the College of Physicians and Surgeons, New York, died in London, on December 10.

DR. MAX W. HAUSCHILD, professor of anatomy at the University of Berlin, died on October 2, after his return from a research expedition to the Dutch Indies.

GERARD KALSHOVEN GUDE, of England, authority on tropical land mollusca, died on November 8, aged sixty-six years.

PROFESSOR HERMANN BRAUS, director of the Anatomical Institute, University of Würzburg, eminent for his work in experimental morphology and general anatomy, died on November 28, in his fifty-seventh year.

DR. RUDOLPH GOTTLIEB, professor of pharmacology at the University of Heidelberg, has died, aged 60 years.

THE death is announced of Dr. E. Wertheimer, emeritus professor of physiology at Lille, France.

THE Joint Genetics Sections of the American Society of Zoologists and the Botanical Society of America will present their third annual program at Washington in three sessions on December 29, 30 and 31. The titles of more than fifty papers have been received and these have been divided as follows: A session for botanical papers on Monday afternoon, zoological papers on Tuesday morning and a general session on Wednesday morning. This arrangement avoids conflict with important programs of the botanical and zoological societies on Tuesday and Wednesday afternoons. A program for geneticists interested in agriculture has been arranged tentatively for Monday morning.

THE next Australasian Medical Congress will be held in Dunedin, New Zealand, early in 1927, under the presidency of Dr. L. E. Barnett, who is retiring from the professorship of surgery in the medical school of Otago University, Dunedin. The general secretary of the congress is Dr. W. P. Gowland; the associate secretary, Professor A. M. Drennan, and the treasurer, Professor D. W. Carmalt-Jones.

THE schedule of society meetings at the Chemists Club, New York City, for the remainder of the season 1924–25 is as follows: December 5, Society of Chemical Industry, Grasselli medal; December 12, American Chemical Society, regular meeting; January 9, American Chemical Society, regular meeting; January 16, Society of Chemical Industry, Perkin medal; February 6, American Electrochemical Society (in charge), joint meeting with the Society of Chemical Industry, Société de Chimie Industrielle and American Chemical Society; March 6, American Chemical Society, Nichols medal; March 20, Society of Chemical Industry, regular meeting; April 17, Society of Chemical Industry (in charge), joint meeting with the American Chemical Society, American Electrochemical Society and Société de Chimie Industri-

elle; May 1, American Chemical Society, regular meeting; May 8, Société de Chimie Industrielle (in charge), joint meeting with the American Chemical Society, American Electrochemical Society and Society of Chemical Industry; May 15, Society of Chemical Industry, regular meeting; June 5, American Chemical Society, regular meeting.

FREE lectures and demonstrations are being given at the New York Botanical Garden in the Central Display Greenhouse, Conservatory Range 2, as follows: December 6, "Fruits and seeds in winter," Dr. H. A. Gleason; December 13, "Rubber plants," Dr. A. B. Stout; December 20, "Greenhouse pests," Dr. F. J. Seaver; December 27, "A study of birds and their nests," R. S. Williams.

AT the Baltimore meeting of the American Chemical Society, which will be held during Easter week, the Division of Industrial and Engineering Chemistry will hold a symposium on corrosion. At the present time the tentative outline of the symposium is as follows: 1. Submerged corrosion of metals. *a.* Iron and steel. *b.* Non-ferrous metals. 2. Atmospheric corrosion. 3. Corrosion of special alloys. It is hoped that the scope of the papers of this symposium will cover the problems of corrosion in the heavy chemical industry, in the special chemical industry, in the marine world, in ordnance equipment, in the oil industry, mining industry, etc. Papers relating to any of these subjects or subdivisions will be welcomed by the chairman of the symposium, who is Robert J. McKay.

PAYMENT of $30,000 to the Cooper Institute, New York, for the advancement of science and art is provided for in the will of Eleanor G. Hewitt, sister of Peter Cooper Hewitt.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $1,250,000 has been given by the General Education Board, allied with the Rockefeller Foundation, for completion of the Medical School at the University of Minnesota. The gift carries the proviso that the university obtain elsewhere $2,350,000, which will complete the $3,600,000 estimated cost of the proposed expansion.

UNITS of the new graduate school of medicine of the University of Chicago, projected for immediate construction, include the Billings Hospital, with 200 beds; a medical clinic for internal medicine and the medical specialties, to be occupied by the department of medicine, and a similar surgical clinic for general surgery and the surgical specialties, to be occupied by the department of pathology. This group will also house the Billings Library, a gift from Dr. Frank Billings to the university. The buildings of the physiological group, to be occupied by the department of physiology and the department of physiological chemistry and pharmacology, will be erected on the south side of Fifty-eighth Street and will connect with the hospital group.

WORK will begin shortly on a $20,000 physics laboratory to be known as Founders Laboratory, it is announced at Vassar. The names of the donors have not been made public.

B. MARVEL O'HARRA, assistant metallurgist at the United States Bureau of Mines Experiment Station, Rolla, Missouri, was recently appointed metallurgist and acting director of the station.

APPOINTMENTS to the staff of the University of Pennsylvania School of Medicine have been made as follows: Dr. George Fetterolf, professor of otolaryngology, succeeding Dr. Burton A. Randall, retired; Dr. John Claxton Gittings, professor of pediatrics, succeeding Dr. John P. Crozer Griffith, retired, and Dr. William C. Stadie, assistant professor of research medicine.

DR. H. N. CALDERWOOD, formerly chemist at the U. S. Forest Products Laboratory, is now assistant professor of chemistry at the University of Wisconsin. He has charge of the laboratory instruction given to engineering students. Dr. S. M. McElvain, instructor in chemistry at the university, has taken over the courses in organic chemistry formerly conducted by Assistant Professor Glenn S. Skinner, who has resigned to enter industrial work.

DR. H. O. CALVERY and Dr. H. Jensen have joined the staff of the department of chemistry at the University of Louisville, Kentucky.

DR. L. GRANT HECTOR, former instructor in physics and Tyndall Fellow at Columbia University, has been appointed assistant professor in physics in the College of Arts and Sciences of the University of Buffalo. Dr. P. Thomas McIlroy, of Queens University, Canada, has been appointed instructor in pathology.

DR. ERNEST PICK has been chosen to take the place of Dr. Hans Horst Meyer, professor of pharmacology at the University of Vienna, who has retired.

DISCUSSION AND CORRESPONDENCE

MUSSEL SHOALS

THE Mussel Shoals of the Tennessee River in northern Alabama (between Lauderdale and Colbert Counties) have received their name from the immense number of species and individuals of freshwater mussels (Naiades) which used to be found at this locality. Thus the common and now official spelling "Muscle Shoals" should be discarded for the more correct one "Mussel Shoals." There is no other place upon the

whole wide world which could be compared with this one in this respect. The cause for this unusual development of Naiad-life (as well as other freshwater life) of this region is found in the fact that here two old faunas, in themselves exceptionally rich, come together, the so-called "Cumberlandian," belonging to the upper Cumberland and upper Tennessee rivers, and that of the "Interior Basin" (Ohioan fauna).

I have tried to compile a list of Naiades known from the Mussel Shoals, and have found that about 80 different species and varieties are represented here, belonging to 29 genera, and this number is increased by some additional types known from the tributaries of the Tennessee River in this region.

This extraordinary fact has been recognized at a very early time. Exactly 90 years ago, Conrad[1] wrote:

> The bivalves are . . . peculiarly abundant in those rivers of North Alabama and Tennessee, which have cut their channels in the carboniferous limestone, and where generally a long grass affords them a secure hold against the rapid current of these mountain streams. The expansion of the Tennessee River, known by the name of Muscle Shoals, is of the character I have described; it is shallow, ornamented with a number of small islands, and its bed is full of the long grass which abounds in various species of Naiades. The lover of the grand and the beautiful in natural scenery, as well as the student in science, will here find abundant sources of interest. He will be delighted with a noble river, whose beautiful and numerous islands are clothed with gigantic trees; whose high and undulating shore on the one hand is ornamented with thriving villages, and on the other spreads out an extensive alluvial, rich in all the gifts of Ceres, or rises abruptly from the river a mural escarpment of carboniferous limestone, which reflects its blue and sombre aspect in the crystal waters at its base. Like many other spots, however, remarkable for their loveliness, the subtle messengers of death have chosen it for their abode, infusing the poison of their breath into the serenity of autumn, when the transparency of the air and the purity of the sky, together with the gorgeous scenery, present at first to the unconscious traveller sensations alone of health and enjoyment.

At the present time, the above description holds good only in a small part. The beautiful islands, and the general features of the river itself are gone, as well as a large portion of the fauna, chiefly that of the mussels, which depend on the ecological conditions once presented here. For a dam has been built, the "Wilson Dam," just at the lower end of the "Little Mussel Shoals," about two miles above the town of Florence, ponding the river for many miles, and drowning entirely the "Little" as well as the "Big Mussel Shoals," beginning about four or five miles farther above. With the destruction of the conditions favorable for Naiad-life also the Naiades have been destroyed, which is so much more to be regretted, as there were forms among them which have been found only at this locality, and very likely will be, sooner or later, entirely extinct.

[1] Conrad, T. A., "New Freshwater Shells of the United States." Philadelphia, 1834, pp. 12, 13.

There are some shells yet present in this region, chiefly below the dam; but this is only a small remnant of the original richness of the fauna, and there is great danger that also this remnant will gradually disappear, due to the pollution of the waters which will be a consequence of further "improvements" connected with the dam. And then the "glory of the mussel shoals" will be entirely gone, those characteristic and unique features which would rather have deserved to be kept intact and preserved as a "natural monument," second only to very few other monuments of the United States.

Only one part of Conrad's description has been intensified and emphasized by the present conditions: this is the part which speaks of the "subtle messengers of death," undoubtedly alluding to malaria (and mosquitoes), although Conrad, of course, did not know anything about their connection. But the fact is that mosquitoes and malaria are increasing to such a degree that the inhabitants of Florence and other towns in the vicinity are becoming alarmed, and are beginning to discuss preventive measures.

Truly, a sad state of affairs!

A. E. Ortmann

Carnegie Museum

AS STUDENTS UNDERSTAND IT

The assumption of omniscience in Dr. David Starr Jordan's comments on my list of student misconceptions, published in Science of August 29, reminds me of the old story of the man who consulted a physician for relief from an irritation in his chest. "What is your profession?" asked the doctor. "I play in a brass band," answered the man. "Just the trouble!" exclaimed Medico. "I have always claimed that this excessive blowing of horns was injurious to some lungs; What instrument do you play?" "I beat the bass drum," answered the man.

No one would question the absolute necessity of laboratory contact work in any science course, and the lecture accompaniment should be and doubtless is of a summary and explanatory nature.

In all the science courses at the Virginia Polytechnic Institute, in biological matters there are laboratory courses in invertebrate and vertebrate zoology, six hours a week for one term in each, using Dr. Pratt's two manuals as laboratory guides; in botany, systematic laboratory, 6 hours a week for one term, and in advanced botany, 6 hours per week for one

term. There are also laboratory courses in entomology. The department of bacteriology requires 15 hours per week laboratory work for one term.

It is true that the agricultural students do not get the zoological laboratory, unfortunately, and here Dr. Jordan's strictures will apply; though these men get the botanical, entomological and bacteriological laboratory work.

It may be pertinent, however, to say that the student who gave the answer as to the reptile legs, which answer Dr. Jordan specifically comments upon, had had both the invertebrate and the vertebrate laboratory work and had only recently dissected, among vertebrates, shark, perch, frog, snake, turtle, sparrow and rat.

Ellison A. Smyth, Jr.
Virginia Polytechnic Inst.

I have read the article by E. A. Smyth, Jr., in the October 10, 1924, issue of Science. This discussion is continued by David Starr Jordan, of Stanford University, who raises the question whether after all such ludicrous answers are not explained because of the use of the "lecture" system. He maintains that it is a lack of "contact" or the actual working with plants and animals which brings about a lack of appreciation, or actual knowledge in the minds of our students. In other words, he says, "the results of contact may be permanent."

I did not observe that E. A. Smyth, Jr., obtained the answers quoted as a result of the lecture system—he does not so state in his article. I agree in principle with Dr. Jordan, but in actual practice it does not necessarily work out this way. I am not at all convinced that his method of approach will overcome the lack of thinking and reasoning on the part of our freshmen or even upper classmen. I have been engaged in teaching only about one third as long as E. A. Smyth, Jr., but I have realized that many inane answers may be obtained from "contact" studies in the laboratory as well as from other methods.

"You can lead a horse to water, but you can not make him drink"; also, you can show students the way to knowledge, but you may not be able to make all of them think or reason logically. Working with the hands and using the eyes do not necessarily fix things in the minds of our students.

I am teaching a freshman class in botany this year. I would rather teach freshmen than a group of upper classmen, because they are more ready to be shown and less sophisticated. The intentions of our students undoubtedly are good. Why, then, do we get such answers? It can not be explained by any one cause. To illustrate: we have one experiment in our freshman course in botany which has been recently performed—to determine the need of water for germination of seeds. The experiment was definitely outlined and ample instructions were given. The students were supplied with honey locust seed, blotting paper and files for cutting notches in the seed coats. The students were told to perform the experiment and set the seed aside until the next laboratory class period, when they were to make an examination to see what had happened. After the results were observed, they were told that the experiment illustrated a principle involved in scarifying alfalfa and sweet clover seed to increase the percentage of germination.

In a quiz a few days later, the students were asked to describe an experiment which demonstrates the need of moisture for seed germination. Since the quiz was given a week after the experiment was performed, I am perhaps unreasonable in expecting them to retain the knowledge that long. This was one of the answers:

> The experiment in which the need of moisture for germination was the one where we took the same kind of seeds and placed them in different conditions. One batch of seeds was moistened, *placed in an oven at a hundred degrees centigrade*, while the others were left in the room at regular temperature. The ones in the oven where there was no moisture for germination were not as good as the seeds that were where moisture could get at them.

The young man submitting this answer had a hazy recollection of another experiment which he performed by "contact" and which aims to show the difference between the moisture content of air-dried seed and germinating seed.

Many of these absurd answers, but not all, could probably be explained by the fact that no matter how a course is taught, it seems to be human nature for the youngsters to have their minds on "dates," dances, parties, pep meetings and the Saturday football game while they are engaged in their work. With these things uppermost in their minds, how can we expect thinking and reasoning on the various subjects required in our curricula?

The students of Agassiz lived at a different age, distractions were perhaps not so numerous, students were probably more mature and serious minded and burning with enthusiasm to obtain knowledge. Our youngsters are "burning with enthusiasm" also, but the fire is kindled elsewhere. If Agassiz were teaching in 1924, with his classes largely composed of 16 to 17-year-old students, and if his laboratory had 25 to 30 students instead of five or six, with the present-day environment in place of that which obtained in 1874, it is scarcely a debatable question in my mind as to the nature of some of the answers he would receive.

It is perhaps unfortunate that most of our courses in science must necessarily call for facts instead of entertaining information, but I am not as yet convinced that the doing away with lecture work and emphasizing contact work will greatly improve the situation where our classes are large and the subject-matter required.

I do not, however, want to be understood as being an adherent of the lecture system. The easiest way for any of us to explain the situation seems to be to blame the other fellow—something must be wrong with our secondary schools and the age at which the boys and girls enter college. On the other hand, I believe our students have a right to question in some instances the teaching ability of the instructor. As college teachers, our greatest responsibility is not to teach our undergraduate students primarily facts, but to think. The question in each one's mind should be how this can best be accomplished under the present conditions.

L. E. Melchers
Kansas State Agricultural College,
Manhattan, Kansas

Recently Science published so-called "howlers" composed by students during examinations. While the compositions are humorous in a certain sense, yet they possess a pitiable aspect in revealing the lack of preparation in English and geography and a lack of coordination of thought, especially on the part of students entering college. The following have been selected from the writings of students in several schools and in upper classes as well as first year. The quotations are verbatim.

The preCambrian roch were where in distinct fossil were found. The rocks were mostly ingneous and meta morphosed, with some sedimentation in the proterozoic Limestone was found in the rochs. which lead to evidence of life of some organism The Archean is universal and very thick. This tell it was a long period of time and equal. The proterozoic rocks have eroded some.—

Ripple marks and cross bedding are due to formation within minerals of minor minerals on thin planes.

Continental deposits are deposits formed by wind, such as the Rocky Mountains, these deposits are called stratification.

—magmas extrusively imbedded in the earth's crust.

A loess is made up of a yellowish-brown material which was peculiar to geologists.

A fossil is the historic record of the past geologic conditions of the world and the chief proof of the fact of evolution or the gradual descent of man caused by the decomposition of animals or plants in rocks under conditions favorable for preservation.

Even Bolivia may be found in young and old river valleys.

The ginkgo would have perished after the Mesozoic had it not been cultivated by the Chinese.

Trilobite is a good name because they have feelers.

Gradation is the desire of the earth to level itself.

Stages in development of streams may be compared to stages in children. In infancy they are gullies; in youth they have straight sides and narrow bottoms.

The Rockies were formed between the Cretaceous and the Plastaceous.

Relief features of the second order within the ocean basins are not much concerned with human nature.

If the La Placian hypothesis were true all planets would revolve around the sun once a year.

The agriculture is mostly mining.

Waldo S. Glock
The Ohio State University

The examples of student misinformation submitted by Professor Smyth will doubtless start an avalanche of *Outrageous Biology* from teachers who hitherto have scarcely dared admit what is possible from their students. From my own collection of some years, one which I alternately view with delight and despair, may I submit these gems?

The liver is a capillaraceous organ whose function is to produce a fluid used in digestion and reproduction. Its outlet is the arteries.

Breathing is rhythmic because it takes so long to take in a breath and so long to let it out and we have to rest between. This is controlled by valves, which are in turn regulated by a column of mercury 760 mm in height. Thus we see that when the system is in proper working condition breathing is rhythmic.

Clementina Spencer Momyer

THE RACIAL ORIGIN OF ALMSHOUSE PAUPERS IN THE UNITED STATES

In an article under the above title which appeared in Science for October 31, Dr. Raymond Pearl says:

> While on January 1, 1923, there were in almshouses 59.8 native-born white persons per 100,000 of the same class in the population, the corresponding figure for the foreign-born was 173.6. This is by some regarded as a fact of dread significance. Perhaps it is. To me it seems possibly only an interesting expression of the difficulties which the human organism finds in adapting itself to a new environment.

As an additional factor not to be overlooked I suggest that the native has relatives and old friends who would feel it a disgrace if he had to enter an almshouse and who prefer to help him along and even support him rather than endure it, while the foreign-

born left kin and early associates in another land. Such kin are apt to be poor and in any case are hardly likely to send money to support one who migrated to rich America. We can also remember the huge sums our government pays annually in pensions to Civil and Spanish war veterans and their widows, for these must keep many a native out of the poorhouse, while a much lesser proportion of foreign-born are helped in that way.

ANITA NEWCOMB MCGEE
WOODS HOLE, MASSACHUSETTS

INVESTIGATIONS OF MAGNETOSTRICTIVE PHENOMENA

IN compiling the data for the various tables to appear in the International Critical Tables under the heading of Magnetostriction it is desired that as complete a survey as possible be made of the literature. In the hope of uncovering all possible sources of materials bearing on the various phases of magnetostriction, this call is sent out asking any one who has reprints of articles covering any particular subdivision of the subject to please send reprints of their work to the undersigned and where reprints are not available will those who have made contributions to this field please send references to the same address?

S. R. WILLIAMS,
Cooperating Expert for Magnetostriction
AMHERST COLLEGE,
AMHERST, MASS.

QUOTATIONS

POPULAR SCIENCE EXHIBITIONS

Now that the British Empire Exhibition has come to an end—for this year at any rate—it may be of interest to record some impressions of the manner in which the Royal Society's Exhibition of Pure Science, which was arranged in the government building, has appealed to the public, and of the extent to which it has fulfilled the objects with which it was organized.

The arrangement of this exhibition was undertaken by the Royal Society, at the request of the government, for the purpose of showing the essential part played by pure science among the multifarious interests and activities of the empire. Everywhere in the great exhibition the applications of science to industry were to be seen, but the fundamental work of scientific inquiry, in which many of them had their origin, would have been unrepresented unless some special effort had been made to bring it to the public notice. Accordingly, this exhibition, illustrating many aspects of purely scientific research at the present time, and indicating how industry has developed from similar inquiries in the past, was arranged.

The exhibition has not been without its humors. One was the difficulty of returning a satisfactory answer to the inquirer who, after spending some time in the galleries, said, "Yes, but how do you know there is an atom, and how do you know there are electrons inside it?"; and another, the problem presented by a visitor who, on observing that the Milne-Shaw seismograph has a rotating drum giving a record which has to be changed every twenty-four hours, asked, "What happens if there is an earthquake while you are changing the record?"

Nevertheless, it may be said that the exhibition has been an unqualified success. The public, non-scientific as well as scientific, has been really interested, and some, at least, must have gone away with a clearer understanding of the purposes for which men devote their lives to scientific experiment and inquiry. This success may be attributed largely to the policy adopted of making the exhibition a living one. The exhibits were contributed by scientific workers actually engaged in the researches represented, and supplemented where necessary to illustrate a subject fully, by instruments contributed by some of the leading makers. Wherever possible, actual demonstrations were given, and a scientific staff was in attendance throughout to carry out the demonstrations and to explain the exhibits. This policy was fully justified by the continued interest of visitors.

The handbook published in connection with the exhibition has been of great assistance. In this book is made available, for the small cost of a shilling, a series of non-technical articles on current scientific topics by leading authorities; and the best proof of its popularity is the fact that more than two thousand copies were disposed of, while its sale is increasing as it becomes better known, and is likely yet to continue now that the exhibition is closed.

The encouraging success which has met this attempt to present pure science in a less austere light than often surrounds it in the eyes of the general public, leads naturally to the inquiry as to whether a greater use can not be made of scientific exhibitions as a means to this end. Nothing but good can result from such efforts to spread a clear understanding of the true aims and purposes of science. That pure science is the modern expression of the elementary desire for knowledge—for the discovery of natural truths—that it is only by the disciplined quest in unknown fields that those benefits which science gives to the human race can accrue, is too little understood and too easily lost sight of, because of the very magnitude of the results themselves.

It ought to be possible to make an exhibition of this kind an annual event. The Scientific Products Exhibitions, organized by the British Science Guild in

1918 and 1919; the Scientific Novelties Exhibitions held at King's College, London, in connection with the King Edward's Hospital Fund in January 1923 and 1924, and experience at Wembley show that such displays of scientific work and results are much appreciated by the public. The desire for truth is at least as strong and as laudable an inspiration to the human spirit as the desire for beauty, and an event of this kind might well become to the world of science what the annual exhibition of the Royal Academy is to the world of art.

Such an annual exhibition would serve to maintain interest in the work of scientific inquiry, and help to keep it in the public mind in its just relation to the other activities in life. To men of science it might become a valuable auxiliary to the usual methods of publication of new scientific work, by reaching a wider public than the transactions of the scientific societies or the scientific periodicals can ever hope to do; and to the museums, it could be a source from which to obtain objects of interest from time to time, and thereby do much to prevent such national misfortunes as, for example, the dispersal, during the war, of the apparatus used by H. G. J. Moseley in his historic work on the X-ray spectra of the elements. It is to be hoped, therefore, that whatever facilities or funds are required to secure the continuance of the pure science exhibits and demonstrations now at Wembley will be provided.—*Nature.*

SPECIAL ARTICLES

PERIODIC REVERSAL OF HEART-BEAT IN A CHRYSALIS[1]

WHILE recently[2] studying two freshly formed chrysalids of *Colias eurytheme,* the cuticula of which was still transparent, I noticed that the heart was beating forward in one, as in insects generally, while in the other the direction of the beat was backward. This extraordinary phenomenon led me to watch the heart action of many pupae individually under a binocular dissecting microscope.

The profound internal changes in form of the mature caterpillar when it stops feeding and hangs itself up to shed its skin and become a chrysalis are accompanied by a periodic reversal in the direction of the peristalsis of the dorsal vessel. Beneath the larval skin the mature caterpillar is now wasp-waisted like the butterfly, and its wing buds are well formed. Its heart action then becomes essentially like that of the pupa, which, briefly, is as follows:

A period of rapid pulsation forward at the rate of approximately one wave of peristalsis per second is followed by a pause of 2 to 3 seconds. Then a slower pulsation at the rate of about one beat in two seconds and lasting for about 12 beats (25 seconds) occurs in *both directions,* forward from the third and backward from the fourth abdominal segments. Then the forward wave through the thorax usually stops altogether, and the whole dorsal vessel slowly pulsates backward at the same rate (about 0.5–0.6 beat per second). Toward the end of each phase just preceding reversal, the rate slackens slightly, but in the reversal to run *forward* there is little hesitation. The quick pumping forward is resumed without the noticeable pause that occurs at the end of the forward movement.

The number of beats forward and backward is subject to much variation, but in general the proportion of backward beats to forward increases with age.[3] Thus two larvae ready to pupate gave averages of 29.5 per cent. and 29.2 per cent. beats backward while two pupae, one fresh and one older, gave 41.3 per cent. and 59.2 per cent. backward. They beat as follows:

	Beats backward	Beats forward	Percentage backward	Temperature.
Mature larva				
" "	71	169	29.5	21° C.
" "	47	114	29.2	21° C.
Fresh pupa	78	111	41.3	25° C.
Older pupa	180	124	59.2	21° C.

It should be noted that in the two pupae just mentioned the first 10 to 15 strokes of the "backward" movements were mixed, including a forward pulsation through the thorax.

Another older chrysalis gave 238 beats backward to 196 forward (54.8 per cent. backward), the proportion of backward beats to forward showing no further increase but rather diminishing slightly as the number of beats in each phase lengthened; the backward beats in this pupa slackened to 0.33 beat per second, whereas the forward movement maintained a high rate (1.05 beat per second, temp. 24° C.)

The flow in the caterpillar up to the time when it stops feeding and prepares to pupate is always forward. This was true of every individual observed, but whether moulting affects the direction of circulation in the younger larval stages has not yet been determined. Since the hæmolymph is strongly colored, the outline of the dorsal vessel is clearly visible without a lens, as a dark green median-dorsal band against a paler green background. Closer examination shows that the dorsal vessel lies close to the

[1] Research promoted by a grant from the Joseph Henry Fund.

[2] October 21, 1924.

[3] Exact counts with a stop-watch have been made upon eleven individuals. Thanks are due to Arthur M. Crosman, Joseph H. Berwick, K. W. Weeks, A. H. Lowell and L. J. Obermeier, who have served as timekeepers.

fairly transparent body wall and occupies a furrow traced through the whitish masses of dorsal musculature. The lateral outlines of the pericardium also can easily be distinguished. Mature larvae before the onset of pupation have regularly shown a *complete* reversal, that is, I have been unable to detect at the beginning of the backward phase any forward peristalis in front of the third abdominal segment.

Violent changes in circulation occur at the moment of pupation when the last larval skin is being stripped backward off the body. Relatively long periods then occur when the blood flows rapidly *in both directions,* backward and forward from the third and fourth abdominal somites where it appears to well up from a ventral sinus and to collect as in a transitory ventricle, alternating with much shorter periods of forward movement. While a strong aortic peristalsis directed forward is occurring in the thorax, an extremely strong flow backward occurs in the abdomen, where the dorsal vessel is now much dilated. Periods of flow in both directions lasted, in the caterpillar observed in the act of pupation, at first for about five minutes, alternating with periods of forward motion which were very short (25 seconds); then the forward phase became longer (68–70 seconds). The rate for all movements at first was about one beat per second, becoming only slightly more rapid in the forward phase (1.09 beat per second). During the first hour after shedding the larval skin the period of beating in both directions fell from 5 down to 3 minutes and the rate to 0.77 beat per second (139 beats in 180 seconds). The phase of forward motion, on the contrary, by one count had increased in extent to 111 seconds (113 beats), without further increase in the rate.

After the first day or two of pupal life the cuticula becomes so thick and opaque that it is usually impossible any longer to follow clearly the beating of the heart, but, in a chrysalis of *C. eriphyle* 60 hours after pupation, I observed 123 beats *forward* in 225 seconds (rate, 0.54 beat per sec.), then a very long pause of several minutes without detectable peristalsis, followed by a *backward* phase of 26 beats in 110 seconds (rate, 0.23 beat per sec.). Another backward phase included only 9 beats in 36 seconds (rate, 0.25 beat per sec.). Thus at 60 hours the forward and backward rates have each decreased by one half, though retaining with each other the same relation, and two successive phases are regularly separated by a long period of inactivity. I have not yet been able to determine whether periodic reversal of direction still occurs in the butterfly.

AN EXPLANATION OF PERIODIC REVERSAL

To reach from behind the dome-shaped mesothoracic receptacle for blood at the base of the wings, the aorta is sharply bent ventrad and then like a siphon rises into the huge dorsal sinus, which is cut off from behind by high vertical walls. Into this relatively large hæmolymphatic reservoir for the wings, the fluid is pumped at the rate of one beat per second, till it is full to overflowing. The blood pressure in the wings is now probably at its greatest. Then something happens to relieve the pressure. Up to the time of pupation, immediate reversal of the peristalsis occurs in the thoracic aorta. Then the intense muscular activity of the pupa in relieving itself of the larval skin opens wide the longitudinal ventral sinuses between the thoracic-abdominal muscles; the blood rushes backward into the base of the abdomen where it wells up like a fountain into the pericardial sinus, thence into the heart, and we have, usually for 25 seconds, blood directed forward in the aorta and backward in the abdominal part of the dorsal vessel. Soon the aorta likewise reverses, and the whole dorsal vessel slowly siphons off, so to speak, the accumulated blood distending the bag-like wings. The pressure then being relieved, rapid forward peristalsis (of one beat per second) is once more resumed until the pause comes before the backward phase.

This pause may be interpreted as a period of maximum blood pressure in head and wings. The last forward strokes preceding it were somewhat languid, warning the observer that the pause was coming, that is, pressure was reaching its limit.

The hæmolymph in flowing backward to relieve the pressure meets obstructions. The contracted base of the abdomen, filled with cords of longitudinal muscle crowding upon the sinuses, and probably the smallness of the open ends of the arteries, make back-action difficult and slow. The "aortal chamber," described by Burgess[4] in the adult of *Colias philodice* and recently found by me there and in the chrysalis of *C. eurytheme,* undoubtedly helps largely in sucking in and driving backward the haemolymph.

I have observed in a pupa with aborted wing buds (affected either by disease or a noxious hereditary factor) that the backward phase was almost entirely omitted, being exceedingly short as compared with the forward phase. This shortness of the forward phase I interpret to mean that owing to the small capacity of the wings there is less blood to be pumped backward, so that the pressure is soon relieved and the free movement forward is quickly restored.

Periodic reversal to beat backward, in brief, means better irrigation of the wings, which in the pupa I regard as organs of excretion of uric acid products

[4] Burgess, E., 1881, "Note on the aorta of lepidopterous insects," *Proc.* Boston Soc. Nat. Hist. 21: pp. 153–156.

and probably of carbon dioxide. Reasons for this view will be set forth in detail in a later paper. Moreover, periodic reversal to beat backward means directing the main stream of hæmolymph toward the reproductive organs. This would seem to be a condition most favorable for the growth of the ovaries, which later in the female so fully fill the abdominal cavity.

"One swallow does not make a summer," and pupal circulation in this genus of butterflies may or may not be typical of that in all the different forms of higher insects with complete metamorphoses which make up such a large part of the animal kingdom. Few of them have colored blood, an unfortunate circumstance which is probably responsible for the fact that so little is known of periodic reversal of heart-beat. It has been described in the pupa of the silk-worm, however, by Bataillon.[5]

Periodic reversal in the direction of the heart-beat occurs, therefore, not only in Ascidians but is also an important characteristic of the metamorphosis of some and possibly most butterflies and moths. Wingless female moths are likely to prove an exception.

In the genus *Colias* periodic reversal of circulation is a most important feature in metamorphosis, as it may prove to be in other holometabolous insects.

JOHN H. GEROULD

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THE AGE OF THE PAYETTE FORMATION AND THE OLD EROSION SURFACE IN IDAHO[1]

THE Payette formation, of continental origin, underlies extensive areas in the Snake River Valley south and west of Boise and in neighboring parts of southwestern Idaho and southeastern Oregon. The age of these strata is a matter of interest because they are the principal key to the Tertiary history of this region, and because beds correlated with them have been used in recent years by Umpleby, Lindgren, Blackwelder, Mansfield and others in attempts to establish the age of the widely recognized old erosion surface of central Idaho.

Lindgren,[2] in 1900, divided the Tertiary sediments of the lower Snake River Valley into two formations. The younger, comprising nearly horizontal strata, he termed the Idaho formation, after Cope, and assigned it to the Pliocene. Merriam[3] has since studied and determined a mammalian fauna from the Idaho beds as representing a late stage of that epoch.

The name Payette was applied by Lindgren[4] to the older more deformed strata underlying the Idaho. The formation was originally considered to be upper Miocene in age on the basis of its flora, studied by Knowlton, but in 1900 Lindgren assigned the Payette to the Eocene because of a revision of the flora by Knowlton. In later years, in discussions of the age of the Idaho Erosion Surface, Umpleby has considered the Payette as Miocene and Lindgren has referred to it as "Miocene (or Eocene)." Chaney,[5] in 1918, on the basis of additional plant remains, said ". . . at this time the writer is satisfied to make the reference to the Miocene without further specification." It thus appears that difference of opinion has existed regarding the age of the Payette.

In the course of field studies in the Snake River region the writer secured remains of two mammalian faunas from the Payette. One occurs in the lower part of the formation, in beds beneath the interbedded rhyolite, about one mile north of Rockville, shown on the Silver City Quadrangle of the U. S. Geological Survey. The second was found in the same section in strata overlying the rhyolite, probably disconformably, near Sands, about 11 miles northeast of Rockville. The beds at both localities dip to the north beneath the nearly horizontal Idaho formation, from which they are easily discriminated by their attitude and lithology.

The Rockville or lower fauna includes a proboscidean of the *Tetrabelodon* type, a species of *Hypohippus* resembling other forms in that genus from middle and upper Miocene formations of the Great Basin province, *Merycodus* sp., a large camel, a rhinoceros, fish bones and freshwater shells. Proboscidean remains first occur in North America in the middle Miocene; they are not abundant until upper Miocene time. This fauna may represent the middle Miocene, but it is more probably of upper Miocene age, and possibly even lower Pliocene.

The small fauna from Sands consists mainly of fragmentary *Hipparion* teeth and rodent teeth. The former resemble most closely in their complicated enamel patterns *H. anthonyi* from eastern Oregon and the hipparions from the lower Pliocene Ricardo formation of the Mojave Desert described by Merriam. The age of the fauna is approximately lower Pliocene.

[5] Bataillon, E., 1893, "La métamorphose du ver à soie et le déterminisme évolutif," Bull. Sci. France et Belgique. Tome 25. (Quoted from Henneguy, L. F., 1904. Les Insectes, p. 533).

[1] Published with the permission of the director of the U. S. Geological Survey and the secretary of the Idaho Bureau of Mines and Geology.

[2] Twentieth Ann. Rept., U. S. Geol. Surv., Pt. 3, pp. 93–99, 1900.

[3] *Bull. Geol. Soc. Amer.*, Vol. 29, p. 162, 1918.

[4] Eighteenth Ann. Rept., U. S. Geol. Surv., Pt. 3, pp. 632–634, 1898.

[5] *Am. Jour. Sci.*, Vol. IV, p. 220.

The age of the Payette is, therefore, middle Neocene. This accords with the stratigraphic evidence. The Payette overlies, probably comformably, the Columbia River lavas, which in other localities have been determined to be approximately middle Miocene in age.

Umpleby[6] originally advanced two reasons for considering the old erosion surface of central Idaho as old as Eocene. It was predicated that the sediments of Eocene age in the surrounding region had been derived from the peneplaned area during its reduction. The Payette was not included among these Eocene formations, perhaps because of its uncertain age and because it was believed to occupy valleys cut into the peneplane. But the Payette lies in post-Payette fault valleys and in diastrophic depressions of Payette and post-Payette date, and not in pre-Payette erosion valleys, in the uplifted region of southwestern Idaho. If we apply Umpleby's reasoning, based on derivation, this important body of sediments lying in an area adjacent to the peneplane would date the old surface as middle Neocene.

A second reason for considering the peneplane Eocene was that strata of supposed Miocene age occupied valleys cut during the Oligocene in the old surface in east-central Idaho. If again we use Umpleby's correlation and reasoning but recognize the upper Miocene age of the lower Payette and hence allow lower and middle Miocene time for the erosion of the valleys instead of the Oligocene, the erosion surface would be Oligocene in age instead of Eocene. If the valleys required less than lower and middle Miocene time for their excavation the erosion surface might even have been finished in lower Miocene time.

It appears therefore that, if we follow Umpleby's reasoning, the old surface is younger than Eocene.

JOHN P. BUWALDA
UNIVERSITY OF CALIFORNIA

ORGANIZATION OF THE WEST VIRGINIA ACADEMY OF SCIENCE

A MEETING for the purpose of organizing an Academy of Science was held at Morgantown, W. Va., under the auspices of the West Virginia Scientific Society on Friday, November 28, 1924.

After an address of welcome by President F. B. Trotter, the organization was effected and the following officers elected:

President, Dr. Geo. R. Bancroft, professor of physiological chemistry, School of Medicine, West Virginia University.

[6] "An old erosion surface in Idaho," *Jour. Geol.*, Vol. 20, p. 142, 1912.

Vice-president, B. R. Weimer, professor of biology, Bethany College.

Secretary, Dr. John A. Eiesland, professor of mathematics, West Virginia University.

Treasurer, A. S. White, professor of social sciences, Marshall College.

The following sectional chairmen were elected for the ensuing year:

Biological section, A. M. Reese.
Chemistry and Pharmacy, Earl C. H. Davis.
Engineering, C. R. Jones.
Geology, Mining, John L. Tilton.
Mathematics, Physics and Philosophy, John Eiesland.
Social Sciences, J. E. Winter.

Special features of the meeting were a lecture by the Honorable A. B. Brooks, chief game and fish protector of West Virginia, on "Lighting the lamp of conservation in West Virginia," and, in the evening, an illustrated lecture by Dr. Francis H. Herrick, of Western Reserve University, on "Bird and animal instinct and intelligence."

The following papers were presented:

BIOLOGICAL SECTION

Microscopic Crustacea collected in the Canal Zone: G. S. DODDS.

Breeding of corn for resistance to smut (Ustilago zeae): R. J. GARBER.

Pit of pit vipers: A. M. REESE.

Habits of brook lampreys: W. S. BOURNE.

Some aspects of the axial gradient theory of structural relationship in organisms: B. R. WEIMER.

Discharge and dissemination of fungus spores: N. J. GIDDINGS.

Some aspects of the rôle of temperature in development: L. M. PEAIRS.

Smoke injury to vegetation: J. B. RHINE.

The development of the tetral wall and coats of the pollen grain: P. D. STRAUSBAUGH.

The West Virginia University course in public health: F. E. CHIDESTER.

Migration in animals: F. E. CHIDESTER.

Leaf mold of tomato: R. C. SPANGLER.

The female gametophyte of the Trillium sessile: R. C. SPANGLER.

Fresh water mussels—(Naiades): W. L. UTTERBACK.

CHEMISTRY AND PHARMACY

Synthesis with chloro-ethers: FRIEND E. CLARK.

Variation in mineral content in Morgantown City water: W. W. HODGE.

Molecular orientation on solids in gels: EARL C. H. DAVIES.

ENGINEERING

Bridge-building in West Virginia: R. P. DAVIS.

The use of the strain gage in engineering investigations: G. P. BOOMSLITER.

Tests on suitability of rocks of West Virginia for road-building purposes: R. B. DAYTON.

GEOLOGY, MINING

The terraces along the Monongahela: S. B. BROWN.

The conglomerate rocks of West Virginia: D. B. REGER.

The principles of soil classification: E. P. DEATRICK.

Some of the problems in oil and gas geology: E. R. SCHEFFEL.

Mining machinery: M. L. O'NEAL.

MATHEMATICS, PHYSICS AND PHILOSOPHY

Graphical methods and lines of force: R. C. COLWELL.

Some studies of absorption of light by mixed solutions: E. F. GEORGE.

The map-coloring problem: C. N. REYNOLDS.

The configuration of pencils of cubics: B. M. TURNER.

On the class of a centro-symmetric space in the theory of relativity: JOHN EIESLAND.

Logic in mathematical science: H. E. CUNNINGHAM.

Some low temperature measurements of refractive indices: F. A. MOLBY.

SOCIAL SCIENCES

Teaching of history and social science: J. F. BOUGHTER.

A study of blondes and brunettes: J. E. WINTER.

THE NEW MEXICO ASSOCIATION FOR SCIENCE

THE New Mexico Association for Science in affiliation with the New Mexico Educational Association for Science met at the State University of New Mexico, Albuquerque, on November 6 and 7. The following program was presented:

PRESIDENTIAL ADDRESS

The scientific classification of school children: DAVID S. HILL, State University of New Mexico.

AGRICULTURE

Some factors influencing the permeability of soils: C. W. BOTKIN, New Mexico College of Agriculture and Mechanic Arts.

ARCHEOLOGY

Symmetry in Pueblo pottery forms: KENNETH M. CHAPMAN, associate in ethnology, School of American Research, Santa Fe.

Introduction of weaving in New Mexico: LANSING B. BLOOM, School of American Research, Sante Fe.

Some forgotten settlements in New Mexico: PAUL A. F. WALTER, School of American Research, Santa Fe.

CHEMISTRY

Scientific adjustment to the use of inferior fuels: J. D. CLARK, State University of New Mexico.

Selected methods for the preparation of alkyl phenols: J. H. GRIFFITH, New Mexico State Teachers College, Silver City.

Utilization of oxide slag in plastic bronze manufacture: PAUL P. MOZLEY, Albuquerque High School.

EDUCATION

Faculty control of high school athletics: EDWARD LIGHTON, Albuquerque Public Schools.

The vital need of college courses in modern synthetic geometry: T. G. RODGERS, dean of the New Mexico Normal University.

The teaching of science in the high school: JESSIE SPENCER, Albuquerque High School.

Needed reforms in methods of teaching science: W. H. BALL, New Mexico Normal University.

Modern hygienic requirements in school furniture: CHARLES E. MCCLURE, Albuquerque.

ENGINEERING

Sun engines: T. T. EYRE, State University of New Mexico.

The super-power system for the electrification of the United States: P. S. DONNELL, State University of New Mexico.

SCIENCE OF LANGUAGE

The Ablaut systems of Dlo, Del, Dol and Sup, Svep, Svop: L. B. MITCHELL, dean of the College of Arts and Sciences, State University of New Mexico.

MEDICAL SCIENCE

Progress in tuberculin treatment: L. S. PETERS, Albuquerque.

Recent advances in preventive medicine and sanitation: G. S. LUCKETT, director of the State Bureau of Public Health, Santa Fe.

METEOROLOGY

Long range weather forecasting: R. S. ROCKWOOD, State University of New Mexico.

MINERALOGY

The genesis of the great low-grade copper deposits of the Southwest: E. H. WELLS, president of the New Mexico School of Mines, Socorro.

PHILOSOPHY

The relation between language and thought: GEORGE S. HUBBELL, State University of New Mexico.

PHYSICS

Distortion in vacuum tube amplifiers: R. W. GODDARD, New Mexico State College of Agriculture and Mechanic Arts.

Importance of the Clement and Desormes experiment: R. V. PRITCHARD, New Mexico State College of Agriculture and Mechanic Arts.

PSYCHOLOGY

The relation of intelligence and school progress: BENJAMIN F. HAUGHT, State University of New Mexico.

SCIENCE

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CONTENTS

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THE RELATION OF CHEMISTRY TO AGRICULTURE[1]

THE dedication of a new chemical laboratory to the service of agriculture is an event which suggests to the mind a variety of thoughts for reflection. When an institution of learning replaces a structure inadequate to its needs by one that is larger and more modern, it simply illustrates in a very concrete way the change from the old order to the new which is continually taking place in both the material and intellectual worlds. But when, as in the present instance, the dedication of a new laboratory is in commemoration of a former revered teacher and investigator of agricultural chemistry our thoughts are turned backward as well as forward. Almost unconsciously we begin to reflect upon those principles of our science which were transmitted to us by the chemists of previous generations as a basis for our own development and as a foundation for future progress.

The year 1924, which marks the completion and dedication of the Goessmann Chemistry Laboratory of the Massachusetts Agricultural College, is in many respects an anniversary in the history of agricultural chemistry. It was just one hundred years ago that Justus von Liebig established his famous laboratory at Giessen, where he began a series of epoch-making discoveries that changed the course of chemical and agricultural science. Going back another century to 1724, we find an English clergyman, Stephen Hales, in the retirement of his curacy at Teddington actively engaged in experiments to show how much nourishment plants derive from the air—a group of researches which were incorporated three years later in a well-known treatise entitled, "Vegetable Statics." Going back still another hundred years to 1624, we find a Belgian physician, Jean Baptiste van Helmont, in the intervals of his medical practice at Vilvoorden, experimenting with his newly discovered *spiritus sylvester,* or carbon dioxide. This backward glance of three centuries, to the time when New England was first being settled, takes us to the very threshold of agricultural chemistry as a science, for it was van Helmont who by means of quantitative experiments first pointed out the path of future progress and who, although himself unable to become disentangled from the obstacles of mysticism, was yet the earliest to see an opening through the thick forest of speculation in which the human mind had been vainly circling about for a period of two thousand years.

[1] Address given at the dedication of the Goessmann Chemistry Laboratory of the Massachusetts Agricultural College, Amherst, Massachusetts, October 3, 1924.

Let us pause for a moment to consider the state of agricultural chemistry as it existed prior to the work of van Helmont. Like many other sciences it had made no progress since the time of Aristotle, whose theorizing upon natural phenomena was based upon the doctrine of the four elements. The different characteristics of soils, plants and animals were explained by their variable content in earth, water, air and fire, while the growth, death and decay of living organisms were attributed to a gain or loss in one or more of these four essential elements. An excess of any one of these gave a substance a preponderating share in the properties of hot, cold, dry or wet, as the case might be. The functions of the animal organism were thus attributed to the four humors, each of which was produced from foods of the requisite elementary property, those of a warm nature, such as mustard, being more productive of bile and those of a cold nature, such as melons, being more productive of phlegm. The expression "cool as a cucumber" is simply a survival of this ancient philosophy of nutrition which had its followers well into the eighteenth century. In the same way that the humors were each produced by particular vegetables, we find the latter to require for their growth a similar adaptation of soils, those which were warm being necessary for the plants that generate bile and those which were cold being required for the plants that give rise to phlegm. Such, in substance, was the theory of agricultural chemistry that prevailed before the time of van Helmont.

It is interesting to follow the interpretation of natural processes as the ancient Greeks explained them by their theory of elements. Take the phenomena of combustion as it is described by Heron of Alexandria, one of the most skilful experimenters of antiquity. "Bodies are consumed," he writes in the introduction of his "Pneumatics," "by fire which transforms them into finer elementary substances—namely, water, air and earth. That they are actually consumed is evident from the carbonaceous residue which, although occupying the same or a little less space than before combustion, nevertheless differs greatly with respect to the weight the material had at the beginning."

We have in this passage with its allusions to weight an early hint of the application of quantitative methods to the analysis of organic substances. Heron describes in his "Pneumatics" the most highly developed and elaborate forms of apparatus; without knowing it he had at his disposal every substance and every device necessary for establishing the true composition of the gaseous products of combustion. The only obstacle to his accomplishing this was the general acceptance of a false system of scientific inquiry, which working by the unproductive *a priori* method employed experiments to illustrate preconceived theories rather than to discover new truths. This attitude of mind, which closed the door to all progress, prevailed until the time of van Helmont, who, although himself greatly hampered by some of the inherited ideas of Greek philosophy, was yet among the first to make quantitative chemical experimentation the basis for the acquisition of new knowledge. Let us cite for comparison a combustion experiment of van Helmont which is somewhat similar to the one described by Heron.

> From 62 pounds of oak charcoal there is obtained by combustion one pound of ash. The remaining 61 pounds therefore consist of that spirit of wood (*spiritus sylvester*) which even under ignition can not escape from a closed vessel. This spirit, hitherto unknown, I call by the new name Gas. . . . Many bodies in fact contain this spirit and certain ones are entirely converted into it, not indeed because it is actually present in them as gas (since it could not be held in a compact form but would entirely escape) but it exists there as a condensed spirit, fixed like a corporeal substance from which it may be liberated by the action of a ferment, as in the case of wine, must, bread, mead, and the like.

Van Helmont's identification of the gas formed by the combustion of wood with that obtained by fermentations and by the action of acid upon limestone was one of the first important generalizations in the history of agricultural chemistry. He erred, however, in supposing this gas to be a transformation product of water, which, like the Greek philosopher Thales, he considered to be the elementary basis of all matter. But van Helmont always gave a good explanation for the truth as he saw it and it is interesting to trace the lines of his argument in a famous experiment which has been quoted by many writers upon chemistry from Boyle to the present time.

> I was able [writes van Helmont] to show by the following experiment that all vegetables are produced immediately and materially from the single element water. I took an earthen vessel in which I placed 200 pounds of soil previously dried in an oven. I then watered it with rain water and planted therein a willow branch weighing 5 pounds. After an interval of 5 years the tree which had sprung up weighed 169 pounds and some 3 ounces. The earthen vessel which was always watered when necessary with rain or distilled water was large and embedded in the ground; lest any flying dust should get mixed with the soil an iron cover plated with tin and provided with a large opening closed the mouth of the vessel. I did not determine the weight of leaves which fell during the four autumns. At the end of the experiment I dried the soil again in the vessel and obtained the same weight of 200 pounds lacking about 2 ounces. The 164 pounds of wood, bark and roots were therefore derived from water alone.

As Sir Michael Foster observes, this research is one of which an agricultural experiment station of to-day

need not be ashamed. The conclusion is wrong, to be sure, but the technique is excellent. The experiment is a classic, for it marks the beginning of the quantitative methods by which future progress in agricultural chemical research was to be made.

If we trace a chronological graph for the development of agricultural chemistry we find that it proceeds from remote antiquity, with no indication of progress, in an almost horizontal line until, at the time of van Helmont, it begins to show a slight deviation upward. With the passing decades the contributors to the science occur with greater frequency and the curvature increases, approaching more and more a vertical line. Following van Helmont we note Glauber, one of the earliest advocates of mineral manures; Boerhaave, the first to investigate carefully the chemical composition of plants; Hales, to whose "Vegetable Statics" a previous reference has been made; Margraff, a great student of plant constituents and the discoverer of beet sugar; Ingenhousz and Priestley, who made the first studies upon assimilation; until finally, after passing a number of less prominent chemists, we come at the close of the eighteenth century to the name of Lavoisier, the first to give a clear explanation of respiration, the first to set forth the fundamental law of the cyclic relation between the processes of plant and animal life and the first to make calorimetric studies upon the production of animal heat. Following the constructive work of this great discoverer the names of the contributors to agricultural chemistry come so rapidly that in the thirty years subsequent to Lavoisier's death more new knowledge was acquired than in all previous time.

This rapid sketch of the progress of agricultural chemistry brings us to the year 1824, so momentous for chemistry and agriculture, when Liebig established his laboratory at Giessen, and it will repay us for a moment to consider an interesting fact relating to the career of this chemist. The first years of Liebig's activity at Geissen were spent in zealous cooperation with his friend, Wöhler, in the study of certain problems of plant and animal chemistry, the most important of these being the investigation upon amygdalin, the first of the glucosides, and that upon uric acid. It was during this very productive period of organic research, when the doctrine of compound radicles and other fundamental theories were established, that Liebig was led to consider the practical bearing of the new discoveries in chemistry upon agriculture—the oldest of the human arts. This gradual change of interest from organic to agricultural chemistry was viewed by some of Liebig's friends with apprehension. When Dumas, the victor over Liebig in the famous substitution controversy, asked his rival rather tauntingly how it happened that he came to change so completely from organic to agricultural chemistry, Liebig replied in a bantering way, "I have withdrawn from organic chemistry because with the theory of substitution as a foundation the structure of chemical science can now be built up by workmen; masters are no longer needed." This ironical retort must not be taken too literally; yet it serves to illustrate the completeness with which Liebig had transferred his attention to agricultural chemistry.

We should perhaps consider at this point the scope of the science which Liebig and his followers brought into so great a prominence during the eighteen forties and fifties. The admirers of that delightful Connecticut essayist, "Ik Marvel," will recall in his "Farm of Edgewood" a very entertaining chapter in which the author denies the existence of any such science as agricultural chemistry.

> People talk of agricultural chemistry [he writes] as if it were a special chemistry for the farmer's advantage. The truth is (and it was well set forth, I remember, in a lecture of Professor Johnson) there is no such thing as agricultural chemistry, and the term is not only a misnomer but it misleads egregiously. There is no more a chemistry of agriculture than there is a chemistry of horse-flesh, or a conchology of egg-shells. Chemistry concerns all organic and inorganic matters; and if you have any of these about your barnyards, it concerns them; it tells you—if your observation and experience can't determine—what they are. Of course it may be an aid to agriculture; and so are wet weather, and a good hoe, and grub, and commonsense and industry."

There was always much truth concealed in the levity of "Ik Marvel" and we may indeed well ask ourselves why we speak so constantly of agricultural chemistry and so rarely of agricultural physics or agricultural meteorology. In fact, when we review the titles of the classic books upon the subject, we note an apparent hesitancy on the part of many authors to employ the term "agricultural chemistry." Gyllenberg's ancient treatise, the oldest of all, "The Natural and Chemical Elements of Agriculture," Boussingault's "Rural Economy" and Liebig's "Natural Laws of Husbandry" imply much more than chemistry; Dana's "Muck Manual," Norton's "Scientific Agriculture" and Johnson's "How Crops Grow" are similar illustrations on the part of American authors. It was principally due to the example of Davy, Lawes and Gilbert, Johnston and other English authors that the term "agricultural chemistry" came into extensive use.

Agricultural chemistry in its present generally accepted meaning treats of the composition of soils, crops and animals and of the mutual chemical relations of these in so far as they concern the production of the means of human subsistence and comfort. Like "municipal chemistry," "military chemistry" and similar general expressions, it is a comprehensive term

which includes not only much of chemistry but touches also upon mineralogy, physics, meteorology, plant and animal physiology, mycology and other correlated sciences. The unqualified expression, "agricultural chemistry," is in fact so limited for the field which it is supposed to cover that we can well understand the preference of the older writers for more general terms, such as "rural economy" and "natural laws of husbandry." There is no field of applied chemistry which is broader in its scope or more comprehensive in the circle of its numerous bearings than that pertaining to agriculture. Consider for a moment the relationships of plant to soil and of animal to plant, the compensating balance between the processes of assimilation and respiration, the interplay of chemical, physical and biological forces which produce soil fertility from minerals and from the residues of plant and animal life. The comprehension in its numerous details of a science which involves such complicated factors as these requires a broadness of view that is not found in a narrow specialist. The great chemists who have been interested in husbandry, such as Saussure, Davy, Chaptal, Boussingault and Liebig, were men of broad scientific culture who were attracted to agriculture by the universal character of its appeal. The chemists who gave distinction to early agricultural research in the United States possessed a similar breadth of training. They were men of the type of Johnson, Goesmann, Hilgard and others who established the first state agricultural experiment stations and who, although chemists by profession, could realize that the greatest opportunity for service and progress in agricultural research is in the borderland where chemistry comes into contact with other sciences.

No better illustration can be given of the qualities necessary for producing a successful agricultural chemist than is furnished by the career of Dr. Goessmann. His intimate schooling in the fundamentals of organic chemistry and his technical experience in sugar and salt manufacture enabled him to give agricultural research a practical as well as a scientific trend. Probably no chemist ever succeeded so well as he in the difficult task of combining these two mutually repellent spheres of activity—regulatory work and scientific research—so that we find him simultaneously engaged in inspecting and analyzing commercial fertilizers and in investigating the physiological effect of special chemical manures upon the carbohydrate content of different fruits. His researches upon sorghum and sugar beets, fruit culture, ensilage making, vegetable production, forage crops and animal feeding gave an impress to the character of the work which many experiment stations took up in the early years of their formation. No one had a clearer idea than he of the importance of constantly correlating the work of the field with that of the laboratory or a keener realization of the varied applications of chemistry to all the phases of agricultural research.

As we compare the achievements of Goessmann and his compeers with those of later workers it would seem as if chemists, with the passing of these pioneers, no longer exerted a controlling influence in agricultural science. The first directors of our state experiment stations were mostly chemists, and the problem of chemical fertilizers, to which they gave so much attention, was successfully solved. Has chemistry, with the solution of this great practical problem, ceased to play an important rôle in American agricultural research or have other sciences, hitherto neglected, attained a more commanding position? A brief survey of American agricultural research may help us to answer this question.

According to the latest compilation of the Office of Experiment Stations of the U. S. Department of Agriculture, there are 5,240 research projects now being conducted by the different state experiment stations. Of these, approximately 31 per cent. are classified as relating to field crops, 17 per cent. to horticulture, 9 per cent. to plant pathology, and 8 per cent. to entomology. Over 60 per cent. of the research projects of our agricultural experiment stations relate to crop production or protection, while only about 20 per cent. pertain to the production, nutrition and diseases of farm animals. The major stress which is placed upon crops by our experiment stations is rightly directed, the approximate total value of farm crops and animal products for the United States during 1923 being, respectively, ten and six billion dollars. Of the remaining agricultural projects classified by the Office of Experiment Stations, approximately 10 per cent. relate to soils and fertilizers and 10 per cent. to a miscellaneous group, comprising agricultural economics, engineering, technology, forestry, chemistry, bacteriology and meteorology. In this large list of over 5,000 projects only 76, or 1.4 per cent., are classified under chemistry, these relating principally to the composition of plant and animal products and to methods of chemical analysis. This statistical review of American agricultural research is sufficient to show that although chemists may possibly excel in point of numbers upon the staffs of our agricultural colleges and experiment stations the final aims of agricultural research are but seldom chemical in themselves.

This brief survey we have made does not indicate, however, the proportion of agricultural research projects in which chemistry plays a cooperating part. If the various projects under soils, fertilizers, in-

secticides, nutrition, etc., which in any way invoke the assistance of chemistry be enumerated, they are found to make up over 20 per cent. of the total. A careful review of the situation shows that the rôle of chemistry in agricultural research is not diminishing but increasing, although the results are neither so spectacular nor so strikingly remunerative as in the days of fertilizer examination. Agrarians, horticulturalists, entomologists, pathologists, technologists and other agricultural specialists are employing chemistry to an ever-increasing extent in the solution of their respective problems. If chemists in the past few decades have lost the prominence which they once held in agricultural research it is because they have permitted others to lead in the work of scientific collaboration. Extreme specialization may perhaps have narrowed our vision to the point of overlooking the fact that chemistry in its relation to agriculture is not an end but a means, and thus of neglecting the opportunities in that fertile region where chemistry and the other sciences overlap. It is in the coordination of chemistry with other sciences that the agricultural chemist of the future must be trained. Such an attitude brings not a relinquishment but an enlarged conception of the relations of chemistry to agriculture.

The field is so vast that it is impossible to indicate in this brief address the nature and variety of the problems which await solution. The agricultural chemist is not concerned, as in the early days, with the mere chemical analysis of soils and crops and animals, but rather with the dynamic rôle which is played by the constituents in the soil solution and in the fluids of the living organism. He does not consider the question of fertilizing for the increased production of grain or seed alone, but also for the increased yield of oil or carbohydrate or protein. The old problems of the chemical composition and rôle of humus need to be reopened; old experiments with fertilizers and cattle feeds need to be reviewed and repeated in the light of newer knowledge. What are the effects of the lesser studied elements, such as boron, iodine, fluorine, manganese, aluminum, etc., upon the growth and function of plants and animals? What are the factors which control the acidity or alkalinity of soils and their influence upon the production of different crops? What are the chemical, physical and biological functions of the numerous bacteria, fungi, protozoa and other microorganisms that inhabit the soil? For the solution of these and the many other important problems which might be named, the agricultural scientist needs to equip himself with the latest methods of research and to summon to his aid the resources and appliances of every science, but of chemistry foremost among all. For, after all is said, the chemical elements in their various combinations are the basis for the material existence of soils and crops and animals; eliminate these and the whole fabric of agriculture dissolves, leaving "not a rack behind." No scientist is so competent as the chemist to understand the fundamental laws which underlie the processes of agriculture and no scientists have described so well as chemists the operations of these laws in the classic works upon husbandry.

This new laboratory, which is dedicated to the service and advancement of agriculture, is for the purpose of instruction as well as of research. However great may have been the increase in chemical knowledge during the past century, it is doubtful if the spirit or method of instruction is any better than that employed by Liebig in the laboratory which he established at Giessen just a century ago. It is fittingly described by one of his pupils, the late Professor Johnson, in an address before the Connecticut Board of Agriculture in 1873, when in speaking of the critical method of scientific inquiry, he said:

> It was in that spirit that Baron Liebig instructed the students who gathered in his laboratory from all quarters of the globe to learn the art of making discoveries in science. They were set to testing the truth of some idea, or the connection of some fact, or else to make new observations and discover new facts to lead to new ideas. It was not the novelty or the glory of discovery, but the genuineness of discovery that was regarded as of first importance. He listened patiently to their accounts of each day's progress, considered their plan of investigation, saw the apparatus or arrangements they devised, witnessed the observations they were led to, and heard the theories they imagined. He encouraged, but he criticized. He asked questions, suggested doubts, raised objections. His students were required not only to collect facts, or supposed facts, and to connect and complement them by comparison, analogies and theories but they were made to attack their theories in every weak point and to verify or disprove the supposed facts by scrutiny from every side.

The fruits of Liebig's teaching are a sufficient proof of the value of this method of instruction.

What lessons are so suggestive as the subject-matter of agricultural chemistry for arousing the interest and intelligence of youth! The basic principles of life and culture are here involved and the teacher has at his command a multitude of themes touching all the commonplace phenomena of our daily existence. Such themes have inspired the greatest thinkers, for they form the warp which holds together the fabric of our civilization. It was Emerson who once exclaimed:

> What would we really know the meaning of? The meal in the firkin, the milk in the pan—show me the

ultimate reason of these matters; show me the sublime presence of the highest spiritual cause lurking, as it does lurk, in these suburbs and extremities of nature; let me see every trifle bristling with the polarity that ranges it instantly on an eternal law;—and the world lies no longer a dull miscellany and lumber room but has form and order.

The field of service to which this laboratory is dedicated is fertile; the outlook is vast; the future is full of promise, for never have the opportunities of applying chemistry to agriculture been greater. The reward, moreover, is certain, provided its devotees preserve the spirit and breadth of vision which actuated the founders of our science.

C. A. Browne

Bureau of Chemistry
U. S. Department of Agriculture

PREPROFESSIONAL TRAINING AS REVEALED BY THE NEEDS OF THE PHYSICIAN[1]

The need of premedical training, as a foundation for a medical education, is evident, and its importance is recognized. What is not so clear, however, and what is not so easily decided, is how broad and deep and firm a foundation is required for the medical superstructure. Just as any building must always be considered, as a whole, before the type of foundation can be determined, so, in the same way, the problem of medical education, in its entirety, must be thought of, the better to understand and appreciate the kind of premedical instruction necessary. It is, therefore, hoped that by calling your attention, on the one hand, to what the finished product of a medical school should be, and, on the other hand, to the deficient product that is produced, you will be helped to realize the urgent need there exists for certain modifications of the present-day premedical courses.

The ultimate aim of the science and art of medicine is (1) to preserve or restore health, (2) to prolong life or (3) to alleviate suffering. The most important object of medical education is to prepare young men and young women to carry out these aims, *i.e.,* to qualify them to practice medicine. Since there is such a misunderstanding as to what the practice of medicine implies, and since the premedical teacher should be familiar with what being a physician means, it might not be amiss, at this point, to define it. The practice of medicine implies (1) an ability to diagnose the patient's ailment, and (2) an ability to take care of the patient, *i.e., to* treat him by any one or more of all the known and recognized preventive and remedial measures that the diagnosis might indicate and suggest. Ability to diagnose is, of course, dependent upon a thorough knowledge (1) of the fundamental sciences—normal and pathological physiology, chemistry and anatomy, and (2) of the exciting and predisposing causes of disease. Ability to treat implies first of all an ability to diagnose, because diagnosis indicates and suggests the kind of treatment necessary, and second it presupposes a knowledge of therapeutics which means the taking care of a patient by any one or more of the following measures: (1) preventive, (2) suggestive, (3) dietetic, (4) physical, (5) hydrotherapeutic, (6) medicinal, (7) mechanical, (8) operative, etc., etc. It further assumes a proper and sympathetic attitude towards the patient. In the building up of a medical education, therefore, therapeutics is the ultimate aim. All other subjects are important only in so far as they throw light on it. In other words, the young doctor, the product of the medical school, should be a humanized being, one qualified by education and training (1) to determine, by diagnosis, what measure or measures are indicated, and (2) to faithfully carry out such treatment, or, if he can not do so himself, he will arrange that another, qualified, shall do it for him.

One need not travel far nor search long for evidence that the product of the present-day medical school is being found wanting. While it is clear there is trouble, it is not easy to localize it and determine its cause. Undoubtedly, the public is to blame on the one hand, and, on the other hand, the schools are certainly at fault. Unlike the successful business corporation which is vitally interested in the turning out of its wares in the form of finished products, because that means satisfied consumers and continued success, the schools have been more or less indifferent to the needs of their graduates, their interest in these ceasing largely at commencement time. And so we find, among others, the graduate in medicine, handicapped by his training or lack of training, unable to do full justice to his patients and to himself.

Though irregular practitioners and patent medicine venders have always been with us, and probably always will be, it is a fact that they are thriving to-day as never before. The United States Bureau of Census, in its 1919 report, gives figures which indicate that the value of patent medicines and compounds increased from $83,771,154.00 in 1909 to $102,463,400.00 in 1914 and to $212,185,700.00 in 1919, a percentage increase in the ten-year period, 1909 to 1919, of approximately 250 per cent. B. C. Keller, in an article, "Laity's idea of physician," ap-

[1] Read before the Association of Urban Universities, November, 1923.

pearing in the 1923 July number of the *Illinois Medical Journal,* and quoted in the *Literary Digest* for September 22, 1923, shows that of 6,772 persons, from all walks of life, interviewed, 5,841 or 87 per cent. were against the regular physician as evidenced by their faith in and patronage of irregulars. This state of affairs is, indeed, all the more deplorable when we call to mind the fact that the public is able to enjoy more perfect health and thus to live a more complete life because of the profession of medicine's constant and self-sacrificing efforts in its attempt to prevent disease and preserve health. The gullibility of the public, therefore, must explain, in a measure at least, its attitude towards the profession.

The schools, both medical and premedical, must, however, shoulder the biggest share of the responsibility. Answers to the question, "What do you consider was lacking, if anything, in your medical school course to fit you for your particular work?" asked of Harvard Medical School graduates, in a questionnaire sent to them about twelve years ago ("The profession of medicine," A. B. Emmons), brought out the fact that of all answering practically 50 per cent. agreed on the one point that a knowledge of therapeutics was their greatest lack. While this reflects conditions as they were some fifteen years ago, in spite of splendid advancements made, there still remains much to be done. That needed improvements are necessary to-day is evidenced by such articles as "Medical education as revealed by the war" (N. B. Foster, *J. A. M. A.,* 5/24/19), "The teaching of therapeutics" (Hare, *J. A. M. A.,* Feb., 1920), "The practitioner's view of the defects of medical education" (Blumer, Proceedings of Thirtieth Annual Meeting of Association of American Medical Colleges, March, 1920), etc., which call our attention to existing defects. However, it must be said to the credit of medical educators: (1) that they are aware of these defects, as reference to a series of papers on medical education in the 1919 *Edinburgh Medical Journal,* and a similar series of articles appearing in the Proceedings of the Association of American Medical Colleges, for the past several years, will show, and (2) that they have been and are considering ways and means of improving the medical course.

After duly charging the public on the one hand and the medical school on the other with the responsibilities that are theirs, there remains no small balance of blame that must be charged to the premedical training. When the Council on Education of the American Medical Association, in 1914, required one premedical year, and in 1918 two premedical years, consisting, in both instances, of prescribed courses in the sciences, with freedom in the choice of enough electives to make up the total required hours, for admission to its class A schools, it undoubtedly had for its object a better prepared medical student. Now, after these years of trial, in the light of the evidence presented, it is not at all surprising that it is becoming more and more questionable whether the added requirements are producing the desired results. The fact that two years ago five schools (Johns Hopkins, Cornell, Western Reserve, Leland Stanford Junior and the University of California) were requiring three years or more of premedical preparation for admission, and that now, in addition, five other schools (Yale, Rush, Dartmouth, Pennsylvania and Oregon) have joined them indicates that these ten schools believe the two-year requirement insufficient and inadequate.

The needs of the practitioner of medicine, as revealed by this study, suggest, among others, the following modifications of the present premedical curriculum, and these are respectfully offered for your consideration:

(1) As medicine is an art as well as a science, the cultural subjects and the humanities should be given greater consideration than they now receive. In the present two-year requirement 28 semester hours in the sciences and six semester hours in English are prescribed, but entire freedom is allowed in the choice of enough electives to make up the total number of hours, the emphasis being on the hours and not on the subject-matter. The implication is that the scientific instruction is the important phase of the premedical training and that nothing else matters. While this may be true, so far as immediate needs go, it is equally as true that such reasoning ignores the needs of the future. Both types of subject are certainly very essential and neither can replace the other. Whereas too much emphasis on the scientific side tends to make the student an unsympathetic and "cold-blooded proposition," the broadening influences of these other subjects make for a humanized being. What is needed is a balanced course—one built especially for the student by the combined efforts of premedical and medical educators. And in this connection we might ask—Is not a complete arts and science course, as a premedical requirement, worthy of most careful consideration?

(2) As the physician works with living patients, he must, of necessity, deal with the human mind. Therefore, psychology, now only a recommended subject, should be a required one.

(3) If ever there was need for the break between the premedical and medical subjects, that need certainly does not exist to-day. It is bad, pedagogically, to say the least. As the laws of physics, chemistry and biology must be applied in diagnosing diseases and treating patients, it is highly important, in the

teaching of these subjects, that the instructors understand the relations between their own subject and what follows. This appreciation will be lacking until there is a greater working together of premedical and medical teachers. For, isn't it as important that the instructor in physics, say, should cooperate with the instructor in physiology as it is for the latter to work with the clinical teacher? Therefore, a greater cooperation between the various teachers concerned with the training of a medical student is urged, in the hope that a better correlation of subjects and a more efficient course will follow.

In conclusion, may we anticipate that to your efforts will be due no small amount of credit for making of the future medical graduate a more finished product.

E. W. KOCH

SCHOOL OF MEDICINE,
UNIVERSITY OF BUFFALO

SCIENTIFIC EVENTS

THE NATIONAL SCIENTIFIC SOCIETIES MEETING IN WASHINGTON DURING CONVOCATION WEEK, DECEMBER 29, 1924, TO JANUARY 3, 1925

THERE have been printed in SCIENCE articles concerning the approaching meeting of the American Association for the Advancement of Science and the national scientific societies associated with it. A list of the sections of the association and of the societies with the principal officers, including the addresses of the secretaries, is as follows:

President

J. MCKEEN CATTELL, Garrison-on-Hudson, N. Y.

Retiring President

CHARLES D. WALCOTT, Smithsonian Institution, Washington, D. C.

Vice-presidents and Retiring Vice-presidents for the Sections

Section A (Mathematics)

Vice-president, J. C. FIELDS, University of Toronto, Toronto, Canada.

Retiring Vice-president, HARRIS HANCOCK, University of Cincinnati, Cincinnati, Ohio.

Section B (Physics)

Vice-president, K. T. COMPTON, Princeton University, Princeton, N. J.

Retiring Vice-president, W. F. G. SWANN, University of Chicago, Chicago, Ill.

Section C (Chemistry)

Vice-president, F. G. COTTRELL, Fixed Nitrogen Research Laboratory, American University, Washington, D. C.

Retiring Vice-president, E. W. WASHBURN, National Research Council, Washington, D. C.

Section D (Astronomy)

Vice-president, JOHN A. MILLER, Swarthmore College, Swarthmore, Pa.

Retiring Vice-president, HEBER D. CURTIS, Alleghany Observatory, Pittsburgh, Pa.

Section E (Geology and Geography)

Vice-president, W. C. MENDENHALL, U. S. Geological Survey, Washington, D. C.

Retiring Vice-president, N. M. FENNEMAN, University of Cincinnati, Cincinnati, Ohio.

Section F (Zoological Sciences)

Vice-president, EDWIN LINTON, 1104 Milledge Road, Augusta, Ga.

Retiring Vice-president, E. L. RICE, Ohio Wesleyan University, Delaware, Ohio.

Section G (Botanical Sciences)

Vice-president, G. R. LYMAN, West Virginia University, Morgantown, W. Va.

Retiring Vice-president, C. J. CHAMBERLAIN, University of Chicago, Chicago, Ill.

Section H (Anthropology)

Vice-president, E. A. HOOTON, Peabody Museum, Cambridge, Mass.

Retiring Vice-president, E. A. HOOTON, Peabody Museum, Cambridge, Mass.

Section I (Psychology)

Vice-president, R. S. WOODWORTH, Columbia University, New York, N. Y.

Retiring Vice-president, G. STANLEY HALL, *deceased.*

Section K (Social and Economic Sciences)

Vice-president, THOMAS S. BAKER, Carnegie Institute of Technology, Pittsburgh, Pa.

Retiring Vice-president, JOHN F. CROWELL, 171 Liberty St., Bloomfield, N. J.

Section L (Historical and Physiological Sciences, History of Science)

Vice-president, LOUIS C. KARPINSKI, University of Michigan, Ann Arbor, Mich.

Retiring Vice-president, FLORIAN CAJORI, University of California, Berkeley, Calif.

Section M (Engineering)

Vice-president, A. E. KENNELLY, Harvard University, Cambridge, Mass.

Retiring Vice-president, JOHN T. FAIG, Ohio Mechanics Institute, Cincinnati, Ohio.

Section N (Medical Sciences)

Vice-president, WILLIAM A. MACCALLUM, Johns Hopkins University, Baltimore, Md.

Retiring Vice-president, RICHARD P. STRONG, Harvard University Medical School, Boston, Mass.

Section O (Agriculture)

Vice-president, L. R. Jones, University of Wisconsin, Madison, Wis.

Retiring Vice-president, R. A. Pearson, Iowa State College, Ames, Iowa.

Section Q (Education)

Vice-president, L. A. Pechstein, University of Cincinnati, Cincinnati, Ohio.

Retiring Vice-president, Henry W. Holmes, Harvard University, Cambridge, Mass.

Permanent Secretary

Burton E. Livingston, Johns Hopkins University, Baltimore, Md. (Association mail address: Smithsonian Institution Building, Washington, D. C.)

General Secretary

D. T. MacDougal, Desert Laboratory, Tucson, Ariz.

A. Mathematics

The American Mathematical Society.
Oswald Veblen, *president.*
R. G. D. Richardson, *secretary,* Brown University, Providence, R. I.
December 30–31.

The Mathematical Association of America.
H. L. Reitz, *president.*
W. D. Cairns, *secretary,* Oberlin, Ohio.
December 31–Jauuary 2.

The Pi Mu Epsilon Mathematical Fraternity.
E. D. Roe, Jr., *director-general.*
Warren G. Bullard, *secretary-general,* 117 Redfield Place, Syracuse, N. Y.

B. Physics

The American Physical Society.
Charles E. Mendenhall, *president.*
Harold W. Webb, *secretary,* Columbia University, New York, N. Y.
December 29–31.

The American Meteorological Society.
W. I. Milham, *president.*
Charles F. Brooks, *secretary,* Clark University, Worcester, Mass.
January 2–3.

D. Astronomy

The American Astronomical Society.
W. W. Campbell, *president.*
Joel Stebbins, *secretary,* Washburn Observatory, Madison, Wis.
December 31–January 1.

E. Geology and Geography

The Association of American Geographers.
Curtis F. Marbut, *president.*
Charles E. Colby, *secretary,* University of Chicago, Chicago, Ill.
December 31–January 3.

The Seismological Society of America.
Bailey Willis, *president.*
S. D. Townley, *secretary,* Stanford University, Calif.

The American Geographical Society.
John Greenough, *president.*
Isaiah Bowman, *director,* 3755 Broadway, New York, N. Y.

The National Council of Geography Teachers.
W. R. McConnell, *president.*
Geo. J. Miller, *secretary,* Mankato, Minn.
December 29.

The American Alpine Club.
Harry P. Nichols, *president.*
Walter D. Wilcox, *secretary,* 1526 New Hampshire Ave., Washington, D. C.

F. Zoological Sciences

The American Society of Zoologists.
R. G. Harrison, *president.*
W. C. Allee, *secretary,* University of Chicago, Chicago, Ill.
December 29–31.

The Entomological Society of America.
Charles W. Johnson, *president.*
C. L. Metcalf, *secretary,* The University of Illinois, Urbana, Ill.
December 29–31.

The American Association of Economic Entomologists.
A. G. Ruggles, *president.*
Albert F. Burgess, *secretary,* Melrose Highlands, Mass.
December 31–January 3.

The Eugenics Research Association.
Albert Johnson, *president.*
H. H. Laughlin, *secretary,* Cold Spring Harbor, New York.

American Society of Mammalogists.
Wilfred H. Osgood, *president.*
Hartley H. T. Jackson, *corresponding secretary,* Bureau of Biological Survey, U. S. Department of Agriculture, Washington, D. C.
April 8–10, 1925.

The Wilson Ornithological Club.
Albert F. Ganier, *president.*
Gordon Wilson, *secretary,* State Normal College, Bowling Green, Ky.

G. Botanical Sciences

The Botanical Society of America.
William Crocker, *president.*
I. F. Lewis, *secretary,* University, Va.
December 29–31.

The American Phytopathological Society.
F. D. Fromme, *president.*
R. J. Haskell, *secretary,* U. S. Department of Agriculture, Washington, D. C.
December 29–January 1.

The American Society of Plant Physiologists.
Chas. A. Shull, *president.*

R. B. HARVEY, *secretary,* University of Minnesota, Minneapolis, Minn.
December 29–January 2.

The Botanists of the Central States.
H. C. COWLES, *president.*
EDWARD A. BURT, *secretary,* Missouri Botanical Garden, St. Louis, Mo.

The American Fern Society.
WILLIAM R. MAXON, *president.*
CHARLES S. LEWIS, *secretary,* 835 Edgewood Ave., Trenton, N. J.
January 1.

The Sullivant Moss Society.
ROBERT S. WILLIAMS, *president.*
EDW. B. CHAMBERLAIN, *secretary,* 18 West 89th Street, New York, N. Y.

The Wild-Flower Preservation Society of America.
H. C. COWLES, *president.*
MRS. N. L. BRITTON, *secretary,* New York Botanical Garden, Bronx Park, New York, N. Y.
December 28.

F–G. Zoology and Botany

The American Society of Naturalists.
W. H. HOWELL, *president.*
A. FRANKLIN SHULL, *sercetary,* University of Michigan, Ann Arbor, Mich.
January 1.

The Ecological Society of America.
E. N. TRANSEAU, *president.*
A. O. WEESE, *secretary,* University of Oklahoma, Norman, Okla.
December 30–January 1.

The American Genetic Association.
DAVID FAIRCHILD, *president.*
SEWALL WRIGHT, *secretary,* P. O. Box 354, Pennsylvania Ave. Station, Washington, D. C.

The American Microscopical Society.
B. H. RANSOM, *president.*
PAUL S. WELCH, *secretary,* University of Michigan, Ann Arbor, Mich.
December 31.

The American Nature-Study Society.
M. R. VAN CLEVE, *president.*
MRS. ANNA B. COMSTOCK, *secretary,* 123 Roberts Place, Ithaca, N. Y.
December 29–30.

The Phi Sigma Biological Research Society.
EMORY W. SINK, *president.*
C. J. REED, *secretary,* 5216 Greenwood Ave., Chicago, Ill.
December 29.

H. Anthropology

The American Anthropological Association.
WALTER HOUGH, *president.*
A. V. KIDDER, *secretary,* Phillips Academy, Andover, Mass.
January 1–3.

The American Folk-Lore Society.
ELSIE CLEWES PARSON, *president.*
GLADYS A. REICHARD, *secretary,* Barnard College, New York N. Y.
December 30–31.

I. Psychology

The American Psychological Association.
G. STANLEY HALL, *president, deceased.*
JOHN E. ANDERSON, *secretary,* Drawer 13, Yale Station, New Haven, Conn.
December 29–31.

The Southern Society for Philosophy and Psychology.
BUFORD JOHNSON, *president.*
O. R. HUGHES, *secretary,* West Tennessee State Normal School, Memphis, Tenn.

K. Social and Economic Sciences

The American Political Science Association.
JAMES W. GARNER, *president.*
FREDERIC A. OGG, *secretary,* University of Wisconsin, Madison, Wis.
December 29–31.

The Metric Association.
GEORGE F. KUNZ, *president.*
HOWARD RICHARDS, *secretary,* 156 Fifth Ave., New York, N. Y.
December 29–30.

N. Medical Sciences

The American Physiological Society.
A. J. CARLSON, *president.*
WALTER J. MEEK, *secretary,* University of Missouri, Columbia, Mo.
December 29–31.

The Society of American Bacteriologists.
A. PARKER HITCHENS, *president.*
J. M. SHERMAN, *secretary,* Cornell University, Ithaca, N. Y.
December 29–31.

The American Society for Pharmacology and Experimental Therapeutics.
JOHN AUER, *president.*
EDGAR D. BROWN, *secretary,* University of Minnesota, Minn.
December 29–31.

The American Society of Biological Chemists, Inc.
PHILIP A. SHAFFER, *president.*
D. WRIGHT WILSON, *secretary,* University of Pennsylvania, Philadelphia, Pa.
December 29–31.

The American Society for Experimental Pathology.
A. S. WARTHIN, *president.*
E. B. KRUMBHAAR, *secretary,* Laboratories, Philadelphia General Hospital, Philadelphia, Pa.
December 29–31.

O. Agriculture

The American Society of Agronomy.
M. F. MILLER, *president.*

P. E. BROWN, *secretary*, Iowa State College, Ames, Iowa.
December 31.
The Society of American Foresters.
WALTER MULFORD, *president*.
ROBERT V. REYNOLDS, *secretary*, U. S. Forest Service, Washington, D. C.
December 30–31.
The American Society for Horticultural Science.
M. J. DORSEY, *president*.
C. P. CLOSE, *secretary*, College Park, Md.
December 29–31.
The American Pomological Society.
PAUL C. STARK, *president*.
H. C. C. MILES, *secretary*, Milford, Conn.
The Association of Official Seed Analysts.
M. T. MUNN, *president*.
A. L. STONE, *secretary*, University of Wisconsin, Madison, Wis.
December 31–January 2.
The Potato Association of America.
A. G. TOLAAS, *president*.
WILLIAM STUART, *secretary*, U. S. Department of Agriculture, Washington, D. C.
December 29–January 3.
The American Dairy Science Association.
A. A. BORLAND, *president*.
J. B. FITCH, *secretary*, Manhattan, Kans.
The Crop Protection Institute.

Q. Education

The National Society of College Teachers of Education.
E. F. BUCHNER, *president*.
ARTHUR J. JONES, *secretary*, University of Pennsylvania, Philadelphia, Pa.
The National Society for the Study of Education.
GUY M. WHIPPLE, *secretary*, 10 Putnam St., Danvers, Mass.
The American Federation of Teachers of the Mathematical and Natural Sciences.
R. C. MANN, *president*.
WM. A. HEDRICK, *secretary*, Central High School, Washington, D. C.
The American Philosophical Association.
ALEXANDER MEIKELJOHN, *president*.
C. I. LEWIS, *secretary*, Harvard University, Cambridge, Mass.
The Phi Delta Kappa Fraternity.
LEWIS W. WILLIAMS, *president*.
ABEL J. MCALLISTER, *secretary*, 2118 West 109th St., Chicago, Ill.
December 31.

Societies Not Specially Related to Any Particular Section

The Society of Sigma Xi.
F. K. RICHTMYER, *president*.
EDWARD ELLERY, *secretary*, Union College, Schenectady, N. Y.
December 30.
The American Association of University Professors.
A. O. LEUSCHNER, *president*.
H. W. TYLER, *secretary*, Massachusetts Institute of Technology, Cambridge, Mass.
December 27–29.
The History of Science Society.
L. J. HENDERSON, *president*.
F. L. BRASCH, *secretary*, Department of Terrestrial Magnetism, Carnegie Institution of Washington, D. C.
December 31–January 1.
The Gamma Alpha Graduate Scientific Fraternity.
E. M. GILBERT, *president*.
L. M. HUTCHINS, *secretary*, Fort Valley, Ga.
January 1.
The Sigma Delta Epsilon Graduate Women's Scientific Society.
December 29 and 31.
The Bibliographical Society of America.
AZARIAH S. ROOT, *president*.
The Gamma Sigma Delta Society.
A. F. WOODS, *president*.
J. O. RANKIN, *secretary*, Agricultural Experiment Station, Lincoln, Neb.
The Phi Kappa Phi Fraternity.
J. S. STEVES, *president*.
L. H. PAMMEL, *secretary*, Iowa State College, Ames, Iowa.

SCIENTIFIC NOTES AND NEWS

AT the opening session of the approaching fifth Washington meeting of the American Association for the Advancement of Science, to be held in the Memorial Continental Hall on the evening of Monday, Dcember 29, at 8:30, the Honorable Charles Evans Hughes, Secretary of State, will address the association on "Some aspects of international cooperation." At the same session the retiring president, Dr. Charles D. Walcott, secretary of the Smithsonian Institution, will give the retiring presidential address on "Science and service."

THE executive committee of the council of the American Association for the Advancement of Science will hold its first Washington session at the Cosmos Club, Washington, on Sunday afternoon, December 28, at 4: 00 o'clock. The business to be considered includes some important matters, such as the question of academy affiliation and the interpretation of fellowship rules. Communications for the committee should reach the permanent secretary, at the Smithsonian Institution Building in Washington, before December 26. The executive committee will hold its second session at the New Willard Hotel on Monday, December 29, at 10: 00 o'clock. The council of the association will hold its first Washington session at the New Willard Hotel on Monday, December 29,

at 2:00 o'clock. Communications for the council should be sent to the permanent secretary's office as above.

DR. THEODORE LYMAN, professor of physics at Harvard University, and Dr. Gilbert N. Lewis, professor of chemistry at the University of California, have been elected honorary members of the Royal Society, London.

THE Nichols medal of the New York Section of the American Chemical Society for 1925 has been awarded to Dr. Edward Curtis Franklin, professor of organic chemistry at Leland Stanford University. The medal is bestowed annually "for the research published during the current year which in the opinion of the jury is most original and stimulative to further research."

THE American Institute of Mining and Metallurgical Engineers has awarded its James Douglas gold medal to William H. Bassett, metallurgist of the American Brass Company, Waterbury, Conn.

JOHN W. HOWELL, of Newark, N. J., has been awarded the Edison medal for the year 1924 for his contributions towards the development of the incandescent lamp. The medal is awarded annually by a committee of twenty-four members of the American Institute of Electrical Engineers.

A PORTRAIT bust of Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, was presented to Dr. Flexner on December 13 at a dinner held at the Ambassador Hotel, New York City. The bust is by the Russian sculptor, Konenkov. The presentation was made by a group of friends of Dr. Flexner in appreciation of his influence in the medical and allied sciences, and the dinner was attended by about two hundred persons. Addresses were made by Mr. John D. Rockefeller, Jr., Dr. Phoebus A. Levene, Professor Augustus Trowbridge and Professor T. H. Morgan. Dr. Frederick Peterson read an appreciative poem and the address of presentation was made by Dr. William H. Welch. Mr. Raymond B. Fosdick acted as toastmaster.

HENRY R. KRAYBILL, professor of agricultural chemistry and chemist in the Agricultural Experiment Station of the University of New Hampshire, has resigned to accept a position as biochemist in the Boyce Thompson Institute for Plant Research, Inc., Yonkers, N. Y. Joseph T. Sullivan, formerly graduate assistant in the department of agricultural chemistry, University of New Hampshire, has been appointed assistant biochemist in the institute.

J. A. PIECE, university fellow of the Lick Observatory, has been appointed astronomer at the Dominion Astrophysical Observatory, Victoria, B. C.

DR. JOSEPH S. REICHERT has resigned his professorship in the department of chemistry of the University of Notre Dame, Indiana, in order to accept a position in government work at the Edgewood Arsenal.

P. B. MEYERS has been appointed chemist at the Agricultural Station at the University of Delaware, in the place of L. W. Tarr, who has resigned.

DR. GEORGE DE SCHWEINITZ has been elected trustee of the University of Pennsylvania in place of the late Dr. Robert G. Leconte.

DR. R. K. NABOURS, head of the department of zoology at the Kansas State Agricultural College, has been elected a member of the advisory council of the Eugenics Committee of the United States.

C. E. SKINNER, assistant director of engineering of the Westinghouse Electric and Manufacturing Company, has been elected chairman of the American Engineering Standards Committee.

THE fourth fellowship to be awarded by the Canadian Society of Technical Agriculturists for professional distinction was conferred at its recent annual convention at Guelph, Ontario, on W. T. Macoun, Dominion horticulturist since 1910.

JAMES KENDALL, professor of chemistry at Columbia University, has been named chairman for 1925 of the New York section of the American Chemical Society. Dr. B. T. Brooks, a consulting chemist, is vice-chairman, and D. H. Killeffer, associate editor of *Industrial and Engineering Chemistry,* secretary-treasurer.

DR. ARISTIDES AGRAMONTE, professor of bacteriology at the University of Havana, has been appointed to represent the Cuban government at the third Pan-American Scientific Congress that will take place in Lima, Peru, from December 20 to January 6, 1925.

GEORGE L. MEYLAN, professor of physical education and a member of the faculty of applied science, represented Columbia University at the ceremonies commemorating the fiftieth anniversary of the founding of the Ecole Polytechnique at the University of Brussels, Belgium, held on November 20, 21 and 22.

DR. L. M. MASSEY, head of the department of plant pathology at Cornell University, has been granted sabbatic leave and will spend nine months, beginning January 1, in research at the Boyce Thompson Institute for Plant Research, at Yonkers, New York.

EDWIN H. BRYAN, entomologist on the staff of Bernice P. Bishop Museum, has returned to Honolulu after a cruise of nine months on board the schooner *France* of the Whitney South Seas Expedition. February and March were spent at Nassau, Puka Puka,

the Phoenix Islands and Fakaofo; April and May in Samoa; and the time from June to November was given to a study of the Fiji Archipelago, particularly of the little known islands lying between Viti, Levu and Tonga. The collections made by Mr. Bryan are chiefly insects, land shells and plants; his notes include also ethnological and geological material.

DR. ALICE HAMILTON has returned from Russia to take up her work in industrial toxicology in the Harvard School of Public Health.

THE Rockefeller Institute for Medical Research has invited six specially qualified bacteriologists, selected from as many foreign countries, to come to New York for a three months' course in the methods of cultivation and identification of certain filter-passing microorganisms isolated by Drs. Olitsky and Gates. The bacteriologists, one each from England, France, Belgium, Italy, Germany and Denmark, will arrive about the end of December.

DR. MARGARET B. MACDONALD, associate and research professor of biochemistry at the School of Hygiene, Johns Hopkins University, is visiting the University of Illinois for the year and is doing research work on the biochemistry of yeast.

DR. F. O. ANDEREGG and Dr. P. R. Judy, of Purdue University, have returned from Bedford where they went to make a study of Indiana limestone ledges in connection with an investigation of the causes of efflorescence of limestone.

MRS. ETHEL PARSONS, of the staff of the International Health Board, who for the past three years has been serving as general superintendent of the Service of Nursing and Nursing Education of the National Department of Health of Brazil, is in the United States on leave of absence. She will sail for Brazil on December 20 to resume her post.

DR. KURT KOFFKA, professor of psychology at the University of Giessen, who has come to the United States to lecture at Cornell University, gave during December a series of lectures on the psychology of learning at Harvard University.

BEGINNING on December 12, Dr. Morton Prince, of Boston, gave a series of three lectures at Clark University or abnormal psychology.

ON December 6, Dr. Raymond Pearl, of the School of Hygiene and Public Health, Johns Hopkins University, delivered an address to the Royal Canadian Institute, Toronto, on the subject "The experimental study of life duration."

PROFESSOR A. S. EDDINGTON, of Cambridge University, England, gave a lecture on "The theory of relativity," before the Swarthmore Chapter of Sigma Xi, on December 9. The lecture was attended by about one hundred and fifty members and guests of the chapter.

IN the interest of the American School of Prehistoric Research in Europe, Mrs. George Grant MacCurdy is giving illustrated public lectures on "Prehistoric art and religion." The first lecture of the season was given at Smith College on December 15.

PROFESSOR ERNST J. BERG, of Union College, Schenectady, delivered a course of six lectures during the week of December 1 under the auspices of the department of electrical engineering of Washington University, St. Louis. His subject was "The use of Heaviside's operators in engineering and physics."

AT the opening, October 6, of the new Pathologic Institute of McGill University Faculty of Medicine, Montreal, which owes its being in part to the Rockefeller Foundation, New York, the chief address was delivered by Dr. Arthur E. Boycott, Graham professor of pathology, University of London.

THE Finlayson Memorial Lectures of the Royal Faculty of Physicians and Surgeons of Glasgow were elivered on November 20 and 24 by Sir Leonard Rogers. His general subject was "Pathological evidence bearing on disease incidence in Calcutta," the first lecture dealing with disease in general and the second with simple and malignant tumors.

DR. EDMUND CLARK SANFORD, head of the department of psychology at Clark University, where he had been a member of the faculty for thirty-five years and president of Clark College for eleven years, died suddenly from heart disease on November 22, aged sixty-five years.

ROMEYN B. HOUGH, author of the "Handbook of Trees of the Northern United States and Canada," who was known also for his fascicles of sections of North American woods, has died, aged sixty-seven years.

THE death is announced of Dr. James Mills, for twenty-five years president of the Ontario Agricultural College.

THE deaths are also announced of the following scientific men: Dr. John Beard, lecturer in cytology and comparative anatomy at Edinburgh University; Dr. Alf. Larsen, well-known Swedish engineer; Dr. Karl Hedbom, of Upsala, known for his researches on mycetes; M. L. E. Bertin, for many years director of naval construction in France, known for his work on the theory of waves; Dr. E. König, of Germany, inventor of certain photographic processes; Dr. George Rechenberg, first assistant of the observatory at Breslau; Dr. Gustav Jaumann, professor of physics in the

German Technical High School in Brunn, and Dr. Jaroslav Hlava, professor of pathologic anatomy at Charles University, Prague.

We are informed that on October 10, following an operation for appendicitis, American science lost one of its younger scholars in the death of James Daley McDonald, at Fresno, California. Born at Clarksfield, Ohio, March 17, 1892, he was graduated from Oberlin College in 1913. The following year he entered the graduate school of the University of California where he took the doctorate degree in protozoology under Professor Charles A. Kofoid. His early professional experience was that of a teacher of biology in the Pasadena High School. Later (1917–1919) he was parasitologist of the State Board of Health of California. At the time of his death, and for several years preceding, he held the position of professor of biology at State College, Fresno, California. His four published papers (1919–1922) deal with intestinal parasites. He leaves a wife, three children and many warm friends.

A correspondent writes that Dr. Francis Eschauzier, born at Cadiz, Spain, March 3, 1861, died on November 10. He descended from a family of botanists, and was a British subject. Juan Jacobo Scheuchzer was his grandfather's great grandfather. On his mother's side he belonged to the noble house of Terry, of Cork, Ireland. He had a brother Luis, who died some years ago, and the brothers were much interested in cacti, and to them *Cactus Eschauzieri* was dedicated by Dr. J. M. Coulter. They resided for many years in San Luis Potosí, but Dr. Eschauzier died in Mexico City.

Observers from Mount Wilson and the other observatories in California, University of Virginia, University of Wisconsin, the Harvard and Brown Universities, and possibly from the Yerkes Observatory at Chicago, Princeton University and the United States Bureau of Standards, will go to Middletown, Conn., on January 24, to view the eclipse of the sun at the Van Vleck Observatory connected with Wesleyan University. Apparatus is being sent from some of the observatories for use at Middletown.

The Harvard College Observatory is to establish four temporary photographic stations along the path of totality of the eclipse of the sun of January 24. There will be a station at Buffalo, N. Y., and one on the island of Nantucket. The others probably will be at Poughkeepsie and near New London, Conn.

The Rockefeller Institute for Medical Research has announced the release of the drug known as Tryparsamide for use in the treatment of human and animal trypanosomiasis (African sleeping sickness and *mal de caderas*) and selected cases of syphilis of the central nervous system. This action is based on results reported from clinical investigations which have been in progress for several years. The drug will be manufactured by the Powers-Weightman-Rosengarten Company, of Philadelphia, and will become available through the regular trade channels about January 1, 1925. In releasing the drug for the benefit of the public, the Rockefeller Institute desires it to be known that the institute does not share in any way in profits that may be derived from the sale of the drug and that, with the cordial cooperation of the manufacturers, provision has been made for the maintenance of a schedule of prices on as low a basis as possible.

A preliminary agreement has been signed, which provides land for the erection of the State Psychiatric Institute and Hospital on the site of the Columbia University and Presbyterian Hospital medical center. The agreement, signed by the chairman of the state hospital commission and the chairman of the joint administrative board of Columbia University and Presbyterian Hospital, states that the first buildings constructed will be the new Presbyterian Hospital and the College of Physicians and Surgeons, the remaining land being available for other institutions associating themselves in the development of the medical center. The new psychiatric institute (the old one is on Ward's Island) will have about 150 beds for patients under observation, and will have the use of the medical center outpatient department, thus permitting the observation and treatment of hundreds of other patients, and making possible a great extension of the present research facilities.

The increasing demands for greater and more varied service to the members by local sections of the American Chemical Society have made the problem of financing these various proper activities extremely acute. Besides providing speakers for the monthly meetings many of the sections maintain employment bureaus, public relations committees and various other agencies for entertainment, membership, etc. The Chicago section of the American Chemical Society is seeking to solve this problem by raising an endowment of $25,000 over a period of five years. Each administration will make an effort to raise its quota. Up to the present time the subscriptions total $3,600, most of which has been paid in.

Pope Pius presided on December 14 at the inaugural sitting of the Pontifical Academy of Science. He delivered a brief address emphasizing the efficacy of the studies of the academy and expressing his best wishes for its development. Scientific reports were read on mathematics, chemistry, physiology, medicine, meteorology and natural history.

The Commonwealth Fund has made a grant of $15,000 for a study of foster children, the sum to be

divided equally for use by Dr. L. M. Terman, of Stanford University, and Dr. Frank N. Freeman, professor of educational psychology in the University of Chicago. Dr. Terman will compare foster children and their foster parents and Dr. Freeman will make a comparison between foster children and their brothers and sisters.

MRS. TYNDALL, widow of Professor John Tyndall, has made a donation of £500 to the Royal Society to be used at the discretion of the Tyndall Mining Bequest Committee, as a fund to meet out-of-pocket expenses incurred by the Tyndall Research Student in carrying out his investigations.

THE Japanese government has decided to allot $1,000,000 for the establishment of an Institute for Natural Science in Shanghai. The research work in the institute will include several branches of pathology, anatomy, bacteriology, parasitology, serology and Chinese pharmacology. A yearly grant of $250,000 is to be made. It is hoped that the institute will be completed within three years.

THE Field Museum of Natural History, Chicago, has been given a trust fund of $25,000 by Julius Rosenwald, of Chicago, to be used by the museum without restrictions.

UNIVERSITY AND EDUCATIONAL NOTES

GROUND was broken on November 13 for two buildings at Columbia University to house the departments of physics and chemistry. They will cost $2,150,000.

AN appeal for the Harvard Medical School dormitory among physicians and their friends has resulted in gifts of about $250,000. The university has agreed to invest from permanent funds of the school about $300,000, and there remains about $550,000 to be raised.

POMONA COLLEGE has completed the first stage in its campaign for $3,000,000. More than $800,000 in pledges has been received, assuring the General Education Board gift of $400,000.

GLASGOW UNIVERSITY has received £2,000 from the Bellahouston trustees for the purpose of providing electrical appliances for the department of natural philosophy.

DR. HOMER G. BISHOP, instructor in psychology at Cornell University, has been appointed assistant professor of psychology at Smith College.

DR. GEORGE A. MENGE, retiring chairman of the Chicago section of the American Chemical Society, has been appointed as assistant professor of chemistry at Lafayette College.

DR. ALEXANDER M. BURGESS, of Providence, R. I., has been appointed medical director and assistant professor of biology at Brown University.

PROFESSOR ANDREW ROBERTSON, professor of mechanical engineering in Bristol University, has been appointed principal of Bristol Merchant Venturers' Technical College, in succession to the late Dr. Wertheimer.

Two newly created professorships in the medical faculty of the University of Münster have been filled by the appointment of Dr. Heinrich Többen to the chair of forensic medicine, and of Dr. Hermann Freund, of Heidelberg, to the chair of pharmacology.

DISCUSSION AND CORRESPONDENCE

RELATION BETWEEN THE SURFACE TENSION AND RELATIVE DENSITY OF A LIQUID

MACLEOD has given (Faraday Soc. Trans., 19, pp. 38–41; *Sci. Abs.*, 190, 1924) an empirical relation between the surface tension λ of a liquid, its density ϱ_1 and the density ϱ_2 of the saturated vapor, which is of the form.

$$\lambda = C\ (\varrho_1 - \varrho_2)^4 \qquad (1)$$

where C is a constant which depends only on the nature of the liquid. This relation has attracted some attention, and has been used by Sugden (*Chem. Soc. J.*, 125 pp. 1177–1189, 1924; *Sci. Abs.*, 2391, 1924) in considerations of the molecular volume and constitution of a liquid. May I point out that I have previously obtained the above relation (*Phil. Mag.*, pp. 83–102, Jan., 1911). I have also deduced from theoretical considerations that the constant C is given by

$$C = 32.96\ \frac{(\Sigma \sqrt{m_1})^2}{M^2\ \varrho_c{}^2} \qquad (2)$$

where $\Sigma \sqrt{m_1}$ denotes the sum of the square roots of the atomic weights of the atoms of a molecule relative to the hydrogen atom, ϱ_c the critical density, and m the molecular weight relative to the hydrogen atom. For example, the values of C for the substances methyl formate, carbon tetrachloride, benzene and ether, given by equation (1) are 27.53, 3.99, 45.5 and 62.92, respectively, while equation (2) gives the values 26.93, 3.33, 41.76 and 68.77.

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THE TERMINOLOGY OF HOMOTYPES OF INSECTS

To museums generally, and to those who have not the advantages of a large state museum, in particular, the value of having representative collections of insects (in fact of all groups) comprising specimens known to agree in every detail with the types of the species they represent (homotypes) is a *desideratum* which can not be too strongly emphasized; and the present note has been written in the hope that it will enlist the cooperation of specialists in making such collections a possibility. My object has not been to provide a contribution to the terminology of "types," but mainly to recapitulate the terms which may be applied to typical specimens of a species. The phrases "agrees with type," or "compared with type" are not very satisfactory, as such specimens differ in value according to their locality, and if they are compared by the original describer of the species or not, in addition to which a uniform system of labelling is essential in a large collection. I, therefore, propose the adoption of the following terms by entomologists, which, with a few additions, are essentially the same as those used by Schuchert and Buckman[1] and recognized by Banks and Caudell.[2]

Topotype: t.t.: A specimen from the same locality as the original type of the species, with which it has been compared by a specialist other than the original describer, and found to agree in every particular.

Metatype: m.t.: A topotype, but compared by the original describer of the species.

Homeotype: h.t.: A specimen compared with the type by a specialist, and found to agree exactly, but not from the type locality.

Idiotype: i.t.: A homeotype, but compared by the original describer of the species.

Neotype: n.t.: A specimen from the same geographical region, preferably from the type-locality, chosen by a specialist or by the original describer, to replace a holotype which is destroyed or lost, or useless for comparison.

The selection of neotypes would to some extent be eradicated if typical specimens were properly labelled, as would be the necessity for regarding some species in the future as "unrecognizable;" and a proper appreciation of the fragility of insect types should in itself be an incentive to the adoption of the above terms. I would also propose that specimens which have been identified only from a description or figure should bear a label indicative of this fact. The letters "i.d." (= "identified from description") written on a corner of the determination label would serve the purpose. To facilitate recognition in the cabinet typical specimens should bear a distinctive label as shown in the circlets after the terms, and it is also necessary that the authority for the identification should be made evident in the accompanying specimen label.

Homeotype.
Sphecodes
gibbus Linn.
det. R. Jones, 24

Homeotype.

A word on the necessity for the uniform designation of the primary types may not be out of place here. It is now more or less universally accepted that only one specimen of a species can represent its "type" (*Holotype*), the other specimens before the author at the time of describing being known as *paratypes,* and the type of the opposite sex to the holotype as the *Allotype.* An allotype which is described after the publication of the original description should be known by Mr. J. H. Durrant's term *Neallotype.* Many authors, however, still follow the practice of calling one specimen the type and the other examples at the time of describing cotypes, while others name all original specimens "types." This leads to much confusion, and it is desirable that a uniform system should be established and rigorously followed. The series of specimens called "types" by some authors are really cotypes, and the selection of a *lectotype* from among such series merits more universal attention. It need hardly be mentioned that lectotypes should be selected with great care. After a lectotype has been selected the remaining "types" which agree with it are known as *paralectotypes.*

The mere creation of terms for various kinds of "types," "morphs," etc., will serve no useful purpose unless the authors themselves consistently employ them. The terms of entomological nomenclature are in need of a severe revision and if this note directs attention to this need and the necessity for eliminating all unnecessary terms its aims will have been accomplished.

CEDRIC DOVER

LONDON

[1] *Ann. Mag. Nat. Hist.*, 7, xvi, p. 102, 1905.

[2] "The Entomological Code," pp. 14 and 15: Washington, 1912.

THE COSTS OF MEDICAL JOURNALS

THE enclosed sheet, showing the comparative costs of various journals to subscribers, was prepared by the publisher, J. Springer of Berlin. It was given to me through the kindness of Professor Kurt Koffka of Giessen, who is now acting professor of education in Cornell University. In these days of increased printing cost, this comparison of German, English and American prices may be of interest to scientific men. The figures give the price in cents per sheet of sixteen pages.

German	Price per sheet (16 pages)	English	Price per sheet (16 pages)	American	Price per sheet (16 pages)
Archiv für Dermatologie und Syphilis	$0.19	*British Journal of Dermatology and Syphilis*	$0.30	*Archives of Dermatology and Syphilology*	$0.06
Archiv für Gynäkologie	.21	*Journal of Obstetrics and Gynecology of the British Empire*	.24	*American Journal of Obstetrics and Gynecology*	.15
Brauer's Beiträge zur Klinik der Tuberkulose mit Zentralblatt für Tuberkulose	.21	*British Journal of Tuberculosis*	.18	*American Review of Tuberculosis*	.11
v. Greefe's Archiv für Ophthalmologie	.28	*British Journal of Ophthalmology*	.25	*Archives of Ophthalmology*	.15
				American Journal of Ophthalmology	.14
Pflüger's Archiv für die gesamte Physiologie	.22	*Journal of Physiology*	.27	*Journal of General Physiology*	.09
Zeitschrift für Hals,- Nasen und Ohrenheilkunde	.17	*Journal of Laryngology and Otology*	.16	*Laryngoscope*	.14
Zeitschrift für Hygiene	.19	*Journal of Hygiene*	.31	*Journal of Hygiene*	.15
Zeitschrift für Kinderheilkunde	.23	*British Journal of Children's Diseases*	.34	*Journal of Diseases of Children*	.06
Zeitschrift für die gesamte Neurologie und Psychiatrie	.30	*Journal of Neurology and Psychopathology*	.32	*Archives of Neurology and Psychiatry*	.07

CORNELL UNIVERSITY

SETH WAKEMAN

QUOTATIONS

INTERNATIONAL CONGRESSES

It will be remembered that the National Union of Scientific Workers issued in May a vigorous protest against the boycott of ex-enemy nations organized by the "International Research Council." This protest was given a fair amount of publicity in the press, though some journals, in particular *Nature* and *The Times,* declined to print it; and copies were sent to the principal scientific societies in Great Britain, and to a selection of foreign academies and societies.

A good many replies have been received. A number of these (for example, those of the Royal Society and the Royal Astronomical Society) are merely formal acknowledgments, stating that the secretary will bring the matter before the council of the society.

Some few societies, however, have already found time to consider the question. Thus the Optical Society has passed a definite resolution of sympathy with the attitude of the Union. The Meteorological Society is "not opposed" to the admission of ex-enemy nations to international Unions and Congresses. The Geological Society and the London Mathematical Society have never associated themselves with the boycott.

No society has, at present, expressed an opinion on the opposite side; and there can be no reasonable doubt that the Union's claim to represent, in this matter, "an overwhelming majority of British men of science," was perfectly justified.

A considerable number of replies have been received from German academies. These naturally all express agreement with our resolution, and gratitude to the Union for the stand it has taken. . . .

One "international" congress was held during the summer, the Mathematical Congress at Toronto. In connection with this, our protest excited a good deal of attention in America. It is an instructive comment on the manner in which the boycott has been organized, that many American mathematicians who attended the congress discovered for the first time when they arrived at it that Germans were excluded. A good deal of indignation was expressed, and the representatives of the American Mathematical Society moved a resolution for the removal of the ban. This

was supported by the delegates of Denmark, Great Britain, Holland, Italy, Norway, Sweden and Switzerland. It was then pointed out (as any reader of our protest could have foretold) that such a resolution was contrary to the statutes of the "International Research Council," under which the congress had been convened. In these circumstances no resolution could be carried, but it was agreed that the attention of the council should be called to the discussion; and the official proposal that the next congress should be held in Brussels, under the present regulations, was withdrawn.

It is safe to say that the Toronto congress was the last "boycott" congress of mathematics. It is possible that the International Research Council will themselves remove the ban when they meet next year. If they do not, the Union of Mathematics will collapse, or degenerate into a purely Franco-Belgian affair, and the way will be clear for the revival of a genuinely international congress.—Professor G. H. Hardy in *The Scientific Worker.*

SPECIAL ARTICLES

THE BRIGHTNESS OF MARINE LUMINESCENCE

IN 1922[1] the present writer published a comparison of the brightness of several luminescent substances, including that of a sample of luciferin kindly presented to him by Professor E. Newton Harvey. More recently there have been opportunities to estimate the brightness of luminescence of several marine forms.

In the former experiments[1] use was made of an optical pyrometer of the type in which an incandescent filament is superimposed upon the glowing surface, the brightness of which is to be measured. This instrument was calibrated to read in millilamberts instead of degrees of temperature.

When it comes to the measurement of the light given out by marine forms in the open sea it is almost impossible to use the pyrometer because of the difficulty of bringing these fleeting patches of light into the field of the instrument. It was found possible however by looking at the image of the filament with the right eye, while the left eye was free to observe whatever gleams of light came into the field of unobstructed vision from the water toward which the observer was looking, to adjust the filament to equality of brightness with the luminescence thus observed. Readings made in this manner do not possess quite the degree of certainty of observations made in the usual way upon a fixed and steady source of light, but it was found that they were rather surprisingly consistent and satisfactory and really afforded a quite reliable estimate of the brightness of the luminescence which was to be measured.

Calibration of the instrument when thus used with two eyes is readily made by setting the filament to match the brightness of any convenient surface alternately by the binocular and the monocular method.

The following is a summary of the studies made by the method above described.

1. *At Sanibel Island, Florida:* Although this locality is noted for its marine "phosphorescence," the accounts of brilliant displays given by Rowland Ward[2] being abundantly confirmed by those who are acquainted with the surrounding waters, only the most meager exhibits were in evidence either in the passes of the Caloosahatchie River or along the shore of Sanibel Island during the fortnight in April (1924) when the writer was present. Occasional star-like sparkles and the diffuse luminescence of breaking waves were observable, however, from a fishing stage on the gulf shore of the island. These, which were presumably due to dino-flagellates, were measured.

2. *From Shipboard off the Carolina Coast:* During a trip from Jacksonville to Baltimore a few days later measurements were made of the luminescence of the bow-wave of the steamer and of the glow observable in the wake. In this case as at Sanibel Island the nights were without moon and partly cloudy.

3. *At Woods Hole:* In August of the present year, also during the dark of the moon, measurements were made from the float of the Marine Laboratory. To the members of the laboratory for this privilege and in particular to Professor Harvey, who identified the luminescent organisms, the writer wishes to express his indebtedness.

LIST OF OBSERVATIONS

Locality	Source	Brightness in millilamberts
Shipboard	A diffuse glow in the wake	.0007
"	Diffuse glow of bow wave	.0063
Sanibel Island	Diffuse glow of breaking waves	.0063
" "	Individual flashes of dino-flagellates	.116
Woods Hole	Individual flashes of dino-flagellates	.116
" "	Colonies of hydroids	.033
" "	Mnemiopsis Leidyi	.11 to .30

It is interesting to note that the diffuse glow of breaking waves, as observed at Sanibel and on shipboard, were of the same order of brightness and that

[1] Nichols: SCIENCE, lv, p. 157 (1922).

[2] Ward: "The English Angler in Florida," London, 1898.

the same is true of the flashes of light from dinoflagellates at Sanibel and at Woods Hole. In both localities the measurements were made at quite close range, the excitation of these minute organisms being apparently due to the swirl of water around piles and submerged timbers.

The colonies of hydroids, which were attached to the supporting timbers of the float at Woods Hole, were excited to momentary luminescence by rubbing with the fingers, a procedure suggested by Professor Harvey.

The finely luminescent jellyfish at the foot of the list (Mnemiopsis Leidyi), although rarely seen at Woods Hole, appeared in abundance during the writer's visit. When excited spontaneously by the swash of a quiet sea the brightness was quite uniformly .11 ml. to .12 ml. After lying at rest in a tub of sea water a sudden agitation of the organisms (as by strongly tapping the tub or stirring the water) produced an initial brightness of .30 ml., which could not be immediately repeated by the application of further excitation.

Even the dimmest of the intensities noted above, that of the faint glow observed in the wake of a steamer at sea, is about ten times what would result from the illumination of white objects by a clear but moonless sky. The foam of a breaking wave is not suitable for such a comparison, since one can not be sure of the complete absence of luminosity. A measurement of the very white shell-beach on Sanibel Island at night, which was probably comparable to sea-foam in reflecting power, was therefore selected. It was found to have a brightness of only .00008 millilamberts.

When one contemplates the vast range between such intensities and that, say, of the same beach under the noonday sun, one calls to mind Langley's classical memoir on the least quantity of light necessary to vision.

E. L. NICHOLS

PHYSICAL LABORATORY
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EXPERIMENTS ON THE CULTIVATION OF THE ACTIVE AGENT OF MOSAIC DISEASE OF TOBACCO AND TOMATO

THE experiments here reported relate to the problem of the cultivation of the microbic agent of mosaic disease of tobacco (*Nicotiana tabacum*) and tomato (*Lycopersicum esculentum*).

It was determined as a preliminary that the active agent was readily filterable through Berkefeld filters, sizes "V" and "N." Also the disease was transmitted from the affected tobacco to previously normal tomato plants and similarly from the tomato to tobacco, thus effecting a cross-passage. Furthermore, the signs of the mosaic disease in the tobacco and tomato plants of the initial stock and in those to which the affection was transferred experimentally were identical with those described by other investigators, notably by Allard.

The medium employed in the cultivation tests consisted of an aqueous extract of carefully selected fresh young stems, leaves and shoots from tomato plants which were shown by experiments to be free of the disease. The extract was centrifuged at high speed and filtered twice through Berkefeld "N" filters. The filtrate was retained for use if its final pH was 5.3 — 6.0 (for no artificial adjustment was made by adding acid or alkali), if no evidence of contamination existed and if none of its contained albumins or globulins were precipitated.

Materials for culture were obtained from stout tomato stems or large tobacco leaves which were cut from the plant with a razor. The cut end of the stem or the leaf was sterilized by searing in a flame and a sterile capillary pipette, connected with a small rubber bulb, was inserted into the stem or into the midrib of the petiole of the leaf, in the direction of the long axis. About 0.01 cc of liquid containing the active agent was then aspirated directly into the pipette and inoculated into 3 to 5 cc of the medium, which was then placed in a dark cabinet in the greenhouse, at a temperature of 28 to 30° C.

After seven to ten days or longer, the medium containing mosaic materials showed as a rule a faint, uniform, translucent, almost imperceptible haze. In some instances, no changes could be made out by inspection with the naked eye on comparison with the controls. Stained specimens, however, revealed more granular material than in the latter. Nevertheless, by the available tinctorial methods, by darkfield examination, by supravital and unstained preparations studied with the ordinary microscope, we failed to differentiate formed elements as distinct from the granules or precipitate which were to be found in the uninoculated medium as well.

To determine whether the agent of mosaic disease had multiplied recourse was had to the inoculation of plants. Since the agent is known to be extremely active, even in high dilutions (Allard, Doolittle), careful attention was given to the possibility that a mere transfer of the original active material from tube to tube might be responsible for the results. As will be shown in a more detailed communication to appear shortly, our tests indicated that no interpretation could be made regarding the power of a subplant in artificial media to induce mosaic disease unless the original inoculum in this subplant is diluted at least one part to a million. Under the conditions of our

experiments, this point was reached by the fourth subplant, in which latter the original inoculum was present in an estimated dilution of one to ten million.

If multiplication of the active agent be indicated by the capacity of the fourth and more remote subplants to induce mosaic disease in normal plants, then of 17 attempts to culture the active agent of tobacco and tomato mosaic, all must be considered as successful but one. It was found that normal tomato plants showed the disease on inoculation with early and remote subplants, up to the twelfth, which represented a diluted of the initial inoculum of one to 4×10^{-16}. Once the experimental disease gained a foothold, there was no difference in the severity of the affection following inoculation of the subplants from that induced by the original, undiluted active agent itself. All the characteristic signs regarded as criteria of the disease were present. The experimental mosaic disease induced by the cultural fluids could be transmitted from plant to plant in unlimited series both by direct application of the liquid of the affected plant to previously normal tomato leaves and by inoculation with the material from subplants of the liquid in the artificial medium.

In the course of the experiments a significant fact was noted, namely, that the agent present in remote subplants which can induce the disease was not readily filterable. The nature of the change thus indicated remains to be determined.

The conclusion seems justified that the incitant of mosaic disease of tobacco and tomatoes is a living, microbic body which can be cultivated in an artificial medium.

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THE AMERICAN CHEMICAL SOCIETY

DIVISION OF INORGANIC AND PHYSICAL CHEMISTRY

Graham Edgar, *chairman*
Harry B. Weiser, *secretary*

A re-determination of the heats of oxidation of certain metals: S. W. PARR and J. E. MOOSE. (1) A direct method and apparatus have been perfected for the accurate determination of the heats of oxidation of certain metals. (2) Very pure aluminium, cadmium, cerium, lanthanum, magnesium, molybdenum, tantalum, tin, tungsten, and zinc have been completely oxidized inside a specially designed combustion crucible and the thermal effect of the oxidation measured. (3) Beryllium has been partially oxidized and the thermal effect measured. (4) Certain metals may be completely oxidized inside a Parr oxygen bomb when sized and arranged properly about a fuse wire within a combustion crucible and subjected to thirty atmospheres pressure of oxygen. (5) The values recorded for the same metal agree more closely than those that have been obtained by indirect methods.

The mechanism of acid catalysis of ester hydrolysis: JAMES KENDALL and CECIL V. KING. Freezing point determinations have been made upon dilute aqueous solutions of ethyl acetate; hydrochloric, trichloracetic, monochloracetic and acetic acids; and equimolecular mixtures of each of these acids with ethyl acetate, in concentrations up to the limit of solubility of ethyl acetate. Specific conductivities have been measured, at 0°, upon solutions of these acids and their equimolecular mixtures with ethyl acetate. The velocity of hydrolysis of ethyl acetate, at 0°, was measured, in the latter solutions. The approximate solubility of ethyl acetate, at 0°, in these solutions was noted. Experiments were carried out to determine the effect of the presence of ethyl acetate upon the velocity of inversion of cane sugar when catalyzed by hydrochloric acid. The collected data have been analyzed with the object of determining the state of molecular complexity in the acid-ester solutions, and the effect of water upon acid-ester compounds. The bearing of the results obtained upon the dual theory of acid catalysis and upon Rice's theory of catalysis by unhydrated hydrogen ion has also been considered.

A new energy relation governing liquids and vapors: J. E. MILLS. The author has previously shown in a long series of articles published mainly in the *Journal of Physical Chemistry* that molecular forces obey the law,

$$1. \qquad f = \frac{-m_1 E}{s^2}$$

where f is the force acting between two molecules, m_1 is the mass of a molecule, E is a constant

$$= 31414 \sqrt[3]{\frac{3}{4\pi}} \sqrt[3]{m_1} \mu^1$$

and s is the distance through which the force acts.

It is now shown that under this law

2. $\mu^1 \sqrt[3]{d_o} - \left(\mu^1 \sqrt[3]{d} + \frac{Ej}{2}\right)$ = energy given out on changing from the density at the absolute zero to any other density d (liquid) or D (vapor) $= C\,R\,T \ln \frac{d^o}{d}$.

Ej is the temperature energy of the molecules. C is the constant of Dieterici's equation for the internal heat of vaporization, namely, $\lambda = C\,R\,T \ln \frac{d_o}{d}$

$$3. \quad \mu^1 \sqrt[3]{d_o} = \mu^1 \sqrt[3]{d} + \frac{Ej}{2} + C\,R\,T \ln \frac{d_o}{d} \text{ for liquid}$$

$$= \mu^1 \sqrt[3]{D} + \frac{Ej}{2} + C\,R\,T \ln \frac{d_o}{D} \text{ for vapor.}$$

This equation has been tested for ethyl oxide, di-isopropyl, di-isobutyl, isopentane, normal pentane, nor-

mal hexane, normal heptane, normal octane, benzene, iodo-benzene, carbon tetrachloride and stannic chloride from 0° C. to the critical temperature of the substance. The results calculated from the liquid and from the vapor are in remarkable agreement and in all substances investigated the results agree with the values obtained at the absolute zero. The equation, therefore, confirms in the most striking manner the fact that the molecular attractive forces vary inversely as the square of the distance apart of the molecules. Also the equation gives a new energy relation apparently holding true for all non-associated substances from the absolute zero to the critical temperature of the substances.

A new method of studying electrode potentials: Homer D. Holler. The usual methods of measuring electrode potentials during the flow of current are subject to error because of potential difference due to resistance. The new method distinguishes between electromotive force of polarization and potential difference due to resistance. A resistance-coupled electron tube amplifier is used with an oscillograph for photographically recording the variations in electrode potential without drawing any current from the electrode which is in the grid circuit. Also by superposing an alternating current upon the electrode, the potential difference due to resistance may be obtained by measuring the a. c. component in the plate current with a separately excited wattmeter.

An oscillographic study of electrolytic rectification: Homer D. Holler and John P. Schrodt. The degree of rectification and the energy efficiency obtainable with the "valve" electrode depends upon the electrical characteristics of the circuit as well as the physical dimensions and condition of the electrode. The study of the effect of these factors upon electrolytic rectification resolved itself into an analysis of the wave-form of the rectified current under different conditions. The effects of inductance with and without an iron core, capacity, counter electromotive force and temperature were demonstrated theoretically and confirmed by oscillographic records.

The activation of hydrogen in the creepage corona: F. O. Anderegg and W. N. Herr. Glass wool, previously found active in promoting the oxidation of nitrogen in the creepage corona, has been shown to be more helpful in activating hydrogen than either flint or earthenware fragments or a bare platinum wire. However, the glass wool tube soon loses its efficiency. It may be restored by letting a little air in and then sweeping out or by passing a discharge through pure nitrogen for a few minutes. Traces of oxygen or nitrogen added to pure hydrogen had little effect on the poisoning. Probably an active form of hydrogen is adsorbed on the glass wool.

Some experiments on the self-corrosion of lead: F. O. Anderegg. A study has been made of the corrosion of the commercially pure lead, the 1 per cent. antimony-lead and the 3 per cent. tin-lead used for telephone cable sheath by burying samples in many kinds of soil at room and at incubator temperature, by observing the corrosive action of solutions of varying pH, by making e.m.f. measurements and by metallographic observations. Of the three, tin-lead is most and antimony-lead usually least resistant to corrosion. The self-corrosion increases with the organic content of the soil, with the presence of salts, with the poorness of the drainage and with the presence of mortar, cement, gypsum, etc. It is dangerous to place lead in contact with the soil. Asphalt, if continuous, should give good protection. The complete details are given in Bull. 18 of the Purdue University Engineering Experiment Station.

The solubility of ferrous hydroxide and its effect upon corrosion: W. G. Whitman, R. P. Russell, G. H. B. Davis. (a) *Solubility of ferrous hydroxide.* Experiments are described in which the solubility of ferrous hydroxide has been determined in water and in solutions of varying concentrations of sodium sulfate, calcium chloride, sodium chloride, ammonium chloride, magnesium chloride, sodium dichromate, sodium chromate, sodium silicate and sodium hydroxide. These solutions of ferrous hydroxide were prepared by adding pure iron powder to the deoxygenated salt solutions, which were allowed to stand until saturated with ferrous hydroxide. The solutions were then filtered under hydrogen and analyzed for iron by a colorimetric method. Data are also given whereby the solubility of ferrous hydroxide may be calculated in non-oxidizing salt solutions. The dissociation constant for ferrous hydroxide is calculated as 6×10^{-10}, the ionization in saturated solutions as 30 per cent. at 25° C., and the free energy of formation as 57,200 calories. (b) *Comparison with corrosion data.* Data on the specific rates of corrosion of iron in various salt solutions have been obtained. The corrosion results parallel the solubilities of ferrous hydroxide in the same solutions. It is suggested that this is due to changes in the protectiveness of the rust film with the solubility of ferrous rust, and that decreased solubility causes a decrease in rate of corrosion.

The activity of hydrochloric acid in ethyl alcohol: Paul A. Anderson. From the experimentally determined electromotive forces of cells of the type: H_2, HCl (alcoholic), HgCl, Hg measured at 25° C. over the concentration range 0.01 to 5.0 *M* are calculated the activities, and their coefficients, of hydrochloric acid in anhydrous ethyl alcohol. It is assumed with Danner, *J. Am. Chem. Soc., 44,* 2832, (1922), that $\gamma = \frac{\lambda}{\lambda_0}$ as a first approximation in dilute solutions.

The conductivity of phosgene solutions. I. Solutions of aluminium chloride in phosgene: Albert F. O. Germann. Liquid phosgene forms conducting solutions with aluminium chloride, contrary to the prediction made by Beckmann, as a result of his study of the ebullioscopy of phosgene solutions. The gaseous products of electrolysis are carbon monoxide and chlorine, which in the

type of cell used partially recombine in diffused light to form phosgene before they can be collected. The specific conductance of the phosgene used was of the order of 0.007×10^{-6} at 25°. Three series of conductivity measurements for solutions of aluminium chloride[1] used at 0° made the results at −45° appear of doubtful value, as the value of the cell constant can not be determined directly at this temperature. The value of the specific conductance at 25° rises progressively from the most dilute solutions to a value of 550×10^{-6} for the saturated solution, and increases in conductivity of the order of 10^5.

A preliminary paper on heats of adsorption from solution: D. C. LICHTENWALNER and NEIL E. GORDON. In previous papers, the adsorption of various salts by hydrous ferric and aluminum hydroxide has been reported. In this paper, the heats liberated when these salts are adsorbed by the iron and aluminum are measured, and an attempt is made to draw some conclusions between the heats of adsorption and the total amounts adsorbed. The salts used are potassium acid phosphate, magnesium acid phosphate and magnesium sulphate, with both iron and aluminum oxides.

The influence of hydrogen ion concentration on the adsorption of precipitating ions: HARRY B. WEISER and EVERETT E. PORTER. An investigation of adsorption during the precipitation of colloidal hydrous chromic oxide, at varying hydrogen ion concentrations. The adsorption of salt anions during the precipitation of gels stabilized by hydrogen ion is greater the greater the hydrogen ion concentration. However, the adsorption is appreciable even on the alkali side of the neutral point and is completely nullified only in the presence of an appreciable concentration of hydroxyl iron. The adsorption varies with different precipitating ions at the same hydrogen ion concentration and there is no indication of the formation of definite compounds. The most strongly adsorbed ion precipitates in lowest concentration, in accord with Freundlich's rule. It is probable that Loeb failed to observe the taking up of anions from neutral salts on the alkali side of the isoelectric point of gelatine because he worked with concentrations of salt anions which were too low relatively to that of hydroxyl.

The relation of pore size in silica gels to adsorption of gases and vapors: HARRY N. HOLMES and H. F. WEIDE. The authors found that in silica gels there is an optimum pore diameter corresponding to the maximum adsorption of a particular gas or vapor. A method was devised for preparing highly adsorbent gels with pores differing widely in average diameter. The adsorption of benzene, toluene, acetone, methyl alcohol, ethyl alcohol, acetic acid, methyl propionate and ethyl acetate at equal partial pressures was studied. With these substances molecular volume and critical temperature showed the greatest influence on adsorption.

[1] At — 45°, 0°, and 25°. Anomalous behavior of the cell.

Absolute unit of fluidity: EUGENE C. BINGHAM. The term *reciprocal poise* is not a satisfactory term for the absolute unit of fluidity. The term *rhe* is suggested. Since fluidities are referred to many different temperatures, it is desirable to take the fluidity of water at one temperature as standard. It is proposed that the fluidity of water at 20 degrees be taken for all calibration purposes at 100.5.

Colloid distribution and the capillary rise of sols: T. R. BRIGGS. The capillary rise of sols in filter paper has been studied from the point of view of the distribution of a suspended colloid between a liquid and a solid phase. Anything which peptizes the colloid acts against its adsorption by the paper and favors the capillary rise. Destabilizing agents favor adsorption by the paper and bring about a decrease in the capillary rise. The theory is general and applies to emulsification with finely divided solids and to the process of dyeing with the substantive or colloidal colors.

Colloid distribution and the theory of dyeing with substantive colors: T. R. BRIGGS. From a consideration of the general process of colloid distribution, a special theory of substantive dyeing has been formulated and tested by experiment. A substance which destabilizes the suspension of the dye will act as an assistant in the dyebath up to the point of actual flocculation. A substance which stabilizes the suspension of the dye will act as a restrainer, providing it does not act as a mordant toward fiber and dye. A stabilizing substance and a destabilizing substance may each exert their special effect in the same dyebath. Transition dyes undoubtedly exist which combine with their properties of acid or basic dyes the characteristics of substantive dyes.

The conductivity of suspensions: HUGO FRICKE and STERNE MORSE. One of us has developed the following formula for the conductivity of suspensions of spheroids in terms of the conductivities of the suspending liquid, suspended particles and the shape of the latter, on the assumption that the arrangement of the particles is fortuitous:

$$\frac{K - K_1}{K - K_2}\left(1 - \frac{K_2}{K_1}\right) = \beta \frac{\rho}{1-\rho}$$

where

K = conductivity of suspension

K_1 = conductivity of suspending liquid

K_2 = conductivity of suspended particles

ρ = volume concentration of suspended particles

$$\beta = \frac{1}{3}\left[\frac{2}{1 + \left(\frac{K_2}{K_1} - 1\right)\sigma} + \frac{1}{1 + \left(\frac{K_2}{K_1} - 1\right)(1 - \sigma)}\right]$$

$$\sigma = \int_0^\infty \frac{d\lambda}{\left(1 + \frac{b^2}{a^2}\lambda\right)^{1/2}(1 + \lambda)^2}$$

a = axis of rotation of spheroid

b = conjugate axis of spheroid.

Graphs for β are given for various values of $\frac{K_1}{K_2}$ and $\frac{a}{b}$. The formula has been tested by comparison with Stewart's values for the conductivity of suspensions of red blood corpuscles $\left(\frac{a}{b} = \frac{1}{4.25}\ K_2 = 0\right)$ with agreement to 1 per cent. or less, within the experimental error and with our own experimental data for cream $\left(\frac{a}{b} = 1, K_2 = 0\right)$ with about the same good agreement. The actual size of the particle does not enter in. The value of the shape appears only in the constant β which is not greatly changed by most combinations of $\frac{K_1}{K_2}$ and $\frac{a}{b}$. Graphs for β for various values of $\frac{K_1}{K_2}$ and $\frac{a}{b}$ are given.

The effect of hydrophilic colloids on the size and distribution of particles in electrolytic precipitation. III Macroscopic crystals from evaporation: DORMAN MCBURNEY and WESLEY G. FRANCE. The size of macroscopic crystals formed by evaporation in both the presence and absence of addition agents was studied with basic lead carbonate, using gelatin, tannin, agar-agar and egg albumen, in concentrations from 0 per cent. to 1 per cent. The addition of gelatin or egg albumen was accompanied by the formation of smaller crystals, and by an increase in the number of crystal groups. The samples to which agar-agar had been added showed clumps of crystals branching from a central nucleus. The presence of tannin seemed to inhibit the formation of well-defined crystals. (By title).

A new method for the separation of elements of the rare earths: JAMES KENDALL and BEVERLY L. CLARK. The ionic migration method previously proposed for the separation of isotopes (Proc. Nat. Acad. Sci., *9*, 75 (1923)) has been successfully extended to the fractionation of certain rare earth mixtures. A gel containing the given mixture is placed in a long glass tube, between a section of KCl gel (nearer the anode) and a section of chromic sulphate gel (nearer the cathode). On electrolysis, since the K^+ moves more rapidly than the rare earth ions, and the Cr^{+++} moves more slowly, the two boundaries of the central section remain quite sharp, even after it has travelled a long distance. If the rare earth ions themselves have appreciably different mobilities, the faster ion should accumulate in the front portion and the slower in the rear portion of this section so that a complete separation should readily be obtained. Short runs have been carried out with three mixtures: yttrium-erbium, gadolinium-samarium and neodymium-praseodymium. In the first two cases a 400 cm run gave practically perfect separation, in the last the separation was only partial.

The ammonium carbamate equilibrium: T. R. BRIGGS and V. MIGRDICHIAN. The system solid ammonium carbamate, ammonia and carbon dioxide has been reinvestigated from the point of view of the Mass Law, at temperatures between 10° and 45°, and in the presence of an excess of either one of the gaseous components. The dissociation pressure of ammonium carbamate has also been redetermined between these temperatures. The equilibrium has been found to conform very closely to the requirements of the Mass Law.

The detection of azeotropic mixtures: T. R. BRIGGS. A simple laboratory method of distinguishing between a chemical individual and an azeotropic or constant-boiling mixture has been devised and applied to the systems: hydrochloric acid-water and methyl alcohol-benzene. The method is based on the familiar principle that the azeotropic composition is displaced by a change of pressure. A complete cycle of distillation, reversible with respect of either the residue or the distillate, is described. The method is especially available as a simple and instructive experiment in a course in physical chemistry (By title).

The binary system, silver perchlorate-pyridine, and the ternary system, silver perchlorate-pyridine-water: RUDOLPH MACY. A phase rule study of the binary system has been made from the eutectic to temperatures above 100°, and the solubility curves of 3 molecular compounds determined. The compositions of these compounds were obtained from a study of the ternary system at 25°. They are $AgClO_4.4C_5H_5N$, $4AgClO_4.9C_5H_5N$, and $AgClO_4.2C_5H_5N$. Of these only the first compound was obtained in pure enough form for the composition to be checked by a direct analysis. A complete study of the ternary system was made at 25°.

Germanium tetraethyl: L. M. DENNIS and F. E. HANCE. Germanium tetraethyl was prepared by the interaction of zinc diethyl and germanium tetrachloride in an atmosphere of carbon dioxide, using an apparatus of special design. The compound was shown by analysis to correspond with the formula $Ge(C_2H_5)_4$. It is a colorless, oily liquid boiling at 163.5°, freezing at −90° $\pm$ 0.2°, having a specific gravity of 0.9912 $\frac{24.5°}{24.5°}$ and a refractive index at 20° of 1.4000. It is insoluble in water, miscible in all proportions with ethyl alcohol, diethyl ether, benzene and some other organic solvents. It is not easily attacked by oxidizing agents and is stable in the air under ordinary conditions. It burns with a smoky flame, leaving a residue of the normal and lower oxides of germanium.

The physical properties of monogermane: ROBERT B. COREY. Monogermane, GeH_4, prepared as described in a previous investigation, was carefully purified. The density as gas, the density as liquid, the melting point and the boiling point of the compound were determined, and the tension-temperature curve was plotted. Vapor tension values quite different from those previously published by Schenck were obtained.

The behavior of anhydrous hydronitric acid toward various inorganic salts: A. E. MCKINNEY. A qualitative study of the behavior of anhydrous liquid hydrogen trinitride at 0° toward about 250 solid substances,

chiefly inorganic salts, has been made. It has been shown that this liquid acts as a dissociating solvent toward a large number of inorganic solutes, but shows little or no tendency to form solvates. In the case of certain inorganic salts solvolysis has been found to take place. Qualitative observations have been made on the behavior of the various salts during electrolysis.

Heavy metal azido-dithiocarbonates: G. B. L. SMITH and PAUL WARTMAN. Aqueous solutions of $HSCSN_3$ form insoluble precipitates with $AgNO_3$, $Hg_2(NO_3)_2$, $HgCl_2$, $AuCl_3$, $CuSO_4$, $ZnSO_4$, $Cd(C_2H_3O_2)_2$, Tl_2SO_4, $Pb(C_2H_3O_2)_2$, and $Bi(NO_3)_3$. Of these substances, the following have been identified by analysis, and their chemical and crystallographic properties studied: $AgSCSN_3$, $Cd(SCSN_3)_2.2H_2O$, $Hg(SCSN_3)_2$, $Hg_2(SCSN_3)_2$, $TlSCSN_3$ and $Pb(SCSN_3)_2$. The heavy metals of the first group of the periodic system as well as univalent mercury form amorphous or cheesy precipitates, which are probably highly hydrated. The heavy metals of the second, third and fourth groups form crystalline precipitates of well-defined structure. All these salts in the dry state are sensitive both to shock and heat. The crystalline substances are more or less sensitive to shock, not only in the dry state, but also in contact with the mother liquor. The violence of the explosion appears to be a function of the atomic weight of the basic ion, increasing with rising atomic weight.

Azido-dithiocarbonates of the alkali and alkaline earth metals: L. F. AUDRIETH. Aqueous solutions of alkali and alkaline earth trinitrides react with CS_2 to form the respective azido-dithiocarbonates. The following salts have been isolated, analyzed and identified, and their chemical and crystallographic properties have been studied: $LiSCSN_3.H_2O$, $NaCSN_3$, $NaSCSN_3.2H_2O$, $NaSCSN_3.4H_2O$, $KSCSN_3$, $RbSCSN_3$, $Ca(SCSN_3)_2.5H_2O$, $Sr(SCSN_3)_2.5H_2O$, $Ba(SCSN_3)_2.5H_2O$. Evidence has also been obtained of the existence of the compound $CsSCSN_3$. The K, Rb and probably Cs salts crystallize from aqueous solution in the anhydrous state, while the salts of the alkaline earth metals and of the two transition elements of Group I, Na and Li come out as hydrates. All these salts in the dry state are sensitive both to shock and heat. The violence of the explosion appears to be a function of the atomic weight of the basic ion increasing with rising atomic weight.

Standardization of sodium thiosulfate solution: STEPHEN POPOFF and J. L. WHITMAN. The study of equilibrium conditions between sodium thiosulfate and iodine was made the basis for the determination of the best conditions for the standardization of sodium thiosulfate by iodine, $KMnO_4$, $K_2Cr_2O_7$, $KBrO_3$ and Cu. The normalities of the thiosulfate checked to within 0.05 per cent., regardless of the standard used, except in the case of Cu. Maximum variation among the results was not more than 0.06 per cent. as compared with 0.3 per cent. by other investigators. This accuracy was made possible by the study of the equilibrium conditions, by employing the electrometric method in all titrations even in the standardization of $KMnO_4$ by $Na_2C_2O_4$ (in spite of the common statement that the latter was not possible) and by using a special form of apparatus for weighing the iodine.

Electrometric titrations in acidimetry and alkalimetry without the use of the hydrogen electrode: STEPHEN POPOFF and JOHN MCHENRY. Since the hydrogen electrode requires time to come to equilibrium with any solution, and since it is poisoned or influenced by some substances, platinum wire, especially treated, was made the basis of a study of both titrations in acidimetry and alkalimetry and actual determination of hydrogen ion. The results obtained are good and promising.

The determination of iron: STEPHEN POPOFF, CECIL POWELL and JOHN MCHENRY. The order of the addition of iron and ammonia solutions and the number of reprecipitations in the determination of iron in the presence of sulfates was studied. If double precipitation is used, the order of the addition of iron and ammonia makes no appreciable variation; if single precipitation only is resorted to, the results are low regardless of the order of the addition of reagents (By title).

A sensitive test for copper: STEPHEN POPOFF and CARL W. TUCKER. The use of potassium ferrocyanide as a test for copper in the electrolytic determination of that metal is hardly justifiable even in ordinary work. By substituting haemotoxylin and by using copper gauzes as cathodes and a special form of platinum anode, the accuracy is increased and the cost reduced to a minimum (By title).

A new design circuit breaker for laboratory thermostats: G. FREDERICK SMITH and C. E. HOLLISTER. A modified telegraphic relay presents difficulties as a working part of electrically heated laboratory thermostats. This article describes a device designed with the aim of eliminating these difficulties and fulfils the following qualifications: (1) The power contacts will continuously open and close a 100 watt heating load at 110 volts. (2) The use of condensers has been found unnecessary on voltages up to 110. (3) Springs are eliminated. (4) The magnetizing winding operates at low voltage with low current in order to minimize arching at the mercury contact of the toluene regulator. All dimensions and details of design together with photos and cross-section drawing of the device are given for the purposes of duplication. The apparatus has been thoroughly and favorably tested (By title).

Formation of mother of pearl: F. G. DONNAN. By allowing an aqueous solution of calcium bicarbonate containing gelatin to slowly evaporate, it is possible under suitable conditions to produce a deposition of calcium carbonate in a close Liesegang ring formation, which exhibits diffraction colors nad pearly luster, closely resembling natural mother of pearl in these respects.

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